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ABSTRACT

The utility of the pretraining of task-relevant cognitive skills within the context of experimental research methodology was investigated in this study. A criterion referenced pretraining multi-media product was developed and applied to support the initial phase of an experimental research effort in which several instructional methods for training pilots in an aircraft simulator were investigated. The objectives of the pretraining materials phase of the study were: (1) to provide a standardized, replicable method of orientation of subjects across three experimental groups, (2) to permit the training and assessment of prerequisite entry behaviors which were relevant to the tasks taught in the simulator, and (3) to enhance experimental control for the study. Instructional materials were developed and validated following instructional systems development (ISD) procedures. The materials consisted of a modified programmed text, review questions, a video taped briefing/demonstration, and a criterion test. Materials were validated using two sample groups from the target population of undergraduate pilot training (UPT) casual students. The multi-media pretraining package was applied during the initial or orientation phase of the instructional strategies study. Criterion test scores of the experimental groups receiving pretraining exceeded acceptance criteria for the specified prerequisite skills as called for in the instructional product validation. Achievement scores on the criterion test for the experimental groups closely replicated those of the validation group (non-significant differences in mean scores). (Author/RC)

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DEVELOPMENT AND EVALUATION OF PRETRAINING AS AN ADJUNCT TO A PILOT TRAINING STUDY

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The utility of the pretraining of task-relevant cognitive skills within the context of experimental research methodology was investigated in this study. A criterion-referenced pretraining multi-media product was developed and applied to support the initial phase of an experimental research effort in which several instructional methods for training pilots in an aircraft simulator were investigated. The objectives of the pretraining materials phase of the study were: (a) to provide a standardized, replicable method of orientation of subjects across three experimental groups, (b) to permit the training and assessment of prerequisite entry behaviors which were relevant to the tasks taught in the simulator, and (c) to enhance experimental control for the study. Instructional materials were developed and validated following instructional systems development (ISD) procedures. The materials consisted of a

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modified programmed text, review questions, a video taped briefing/demonstration, and a criterion test. Materials were validated using two sample groups from the target population of undergraduate pilot training (UPT) casual students.

The multi-media pretraining package was applied during the initial or orientation phase of the instructional strategies study. Criterion test scores of the experimental groups receiving pretraining exceeded acceptance criteria for the specified prerequisite skills as called for in the instructional product validation. Achievement scores on the criterion test for the experimental groups closely replicated those of the validation group (non-significant differences in mean scores).

This study demonstrated the value of cognitive pretraining as an adjunct to experimental research methodology in which subjects require training in prerequisite skills prior to formal data collection activities. It also showed that systematically developed, validated instructional materials can facilitate the teaching of prerequisite skills, enhance experimental control, and generally aid in the conduct and administration of a data collection effort.

It was recommended that systematically developed pretraining be further investigated beyond the context of functional orientation and subject preperation. Other possible avenues of investigation include pretraining within the context of the selection of experimental designs for data collection such as pretesting, and investigations of pretraining in which various instructional variables are manipulated.

SUMMARY

Problem

Research in undergraduate pilot training (UPT) often involves the interaction of human subjects, complex tasks, and sophisticated equipment. The orientation and preparation of subjects within such experimental contexts may involve substantial instructional efforts in order to ensure the readiness of the participants. Training in prerequisite skills may require techniques which provide the required testing and training under systematically controlled conditions. Pretraining of extensive prerequisites within the critical experimental environment can be expected to require methodology which exceeds the capabilities of conventional classroom briefings and demonstrations. For example, the applications of instructional systems development (ISD) procedures to the generation of instructional media and achievement tests could potentially satisfy the requirements of a pretraining vehicle within the experimental context.

Approach

To evaluate the potential of pretraining within the context of an ongoing UPT study (Instructional Strategies in the T-40 Trainer), ISD procedures were applied in the generation of a package of multimedia and test instruments to assess the critical prerequisite skills. Major elements in the development of the materials were: (a) analysis of cognitive elements of tasks, (b) development of instructional objectives for pretraining, (c) development of criterion test items, (d) development of instructional sequences (textual and audiovisual materials), (e) validation of materials, and (f) application of materials for pretraining of student subjects assigned to the T-40 study.

The validated test and materials were administered to three groups of subjects at one-week intervals during the initial phase of the instructional strategies study.

Results

The experimental groups attained specified levels of proficiency for the prerequisite cognitive skills, thus satisfying the requirements to participate in the study. Overall test score attainment for subjects was high (92.59 percent) exceeding the criterion of an 85 percent score for 85 percent of the group tested. Variability of test scores for subjects in all three groups was uniformly low (standard deviation 2.33) on the 30-item criterion test. The application of the pretraining materials also facilitated the conduct of the subsequent data collection by: (a) permitting a standardized, replicable orientation/training vehicle for all groups, (b) by generally enhancing experimental control, and (c) by providing direct training and assessment of the required entry skills for all subjects.

Implications

The development of multi-media training materials as applied in this study suggests the general desirability of pretraining as a precurser to flying training studies requiring extensive subject orientation and prerequisite skills assessments. It also suggests that systematically designed instructional materials may have great potential for a wide range of applications in facilitating the conduct of experimental data collections for flying training studies.

PREFACE

This study was conducted in support of Project 1123, Flying Training Development, Dr. William V. Hagin, Project Scientist; Task 112302, Instructional Innovations in USAF Flying Training, Mr. Gary B. Reid, Task Scientist; Work Unit 11230220, Investigation of Alternative Instructional Strategies for Basic Instrument Flight Training in T-40, Ms. Dolores M. Tyler, Principal Investigator, and Captain Robert W. McFadden and Dr. Bernell J. Edwards, Associate Investigators. This report covers research conducted between April 1975 and October 1975.

This study was conducted by the Flying Training Division of the Air Force Human Resources Laboratory (AFSC) in coordination with Headquarters Air Training Command, and supported by the 82d Flying Training Wing and the 96th Pilot Training Squadron commanded by Lt Colonel Albert R. Langford, Williams Air Force Base, Arizona.

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DEVELOPMENT AND EVALUATION OF PRETRAINING AS AN ADJUNCT TO A PILOT TRAINING STUDY

I. INTRODUCTION

Pilot training research often involves the interaction of human subjects, sophisticated equipment, and complex training tasks. The orientation of participant/subjects may become more involved as the complexity of these interactions increases. When the instructional dynamics and experimental controls required by extensive subject orientation exceed the scope of conventional briefings as information vehicles, systematic, criterion referenced instruction may be in order as a logical adjunct to the study.

Training studies involving simulator systems exemplify potential application of the concept of "training-subjects-to-be-trained." Before the subject can properly attend to the central task in the simulator, he must be able to perform certain prerequisite skills (ingress-egress, safety and operating procedures, reading instruments, etc). In cases where prerequisite skills are extensive, training of these behaviors might be accomplished more effectively prior to the time subjects are involved with the principal data task, since the ability of subjects to address the task should be increased (having dispensed with the preliminaries). In addition, simulator operating time required to "train-up" the prerequisite skills would be reduced or eliminated.

The application of such an approach presupposes a systematically developed and administered pretraining phase to support the principal investigation. Since extensive pretraining could potentially confound the study through interactions with main effects and other variables, it would be essential, among other design measures, to carefully analyze task components to insure that adequate differentiation were made between prerequisite behaviors and principal task behaviors. The structure of pretraining at this level of detail would require a validated set of techniques and/or materials which would meet training requirements while providing the required experimental control and procedures replicability.

The application of systematically developed, validated pretraining as an adjunct to undergraduate pilot training (UPT) research efforts may represent a somewhat novel concept. Pretraining in the research context appears attractive and would seem to offer many of the advantages which cognitive pretraining has been shown to afford within other learning contexts in addition to some advantages which seem to be uniquely suited to the experimental research situation.

II. LITERATURE REVIEW

The application of cognitive pretraining as a preparatory phase for subsequently taught skills is not new. The notion of providing the learner with various forms of instructional "priming" is well known and has received considerable theoretical and empirical support in the literature of educational psychology and elsewhere. Cognitive psychologists (and those who favor an information processing approach to learning) have stressed the importance of various forms of pretraining to provide the learner with appropriate cognitive structures for organizing and integrating new information (Ausubel, 1968; Harvey, Hunt, & Schroder, 1961; Hunt, 1971; Roberts & Taylor, 1972; Schroder, Karlins, & Phares, 1973). Some specific methods investigated have included rules, advance organizers, instructional cues, and stimulus predifferentiation.

The facilitative effects of cognitive pretraining upon the acquisition of subsequently-taught perceptual motor skills under varying conditions of task load, stress, and anxiety have also been reported (Bucky, Speilberger & Bale, 1970). In this study pretraining was shown to aid student pilot performance in landing the aircraft under various levels of stress.

Positive affective phenomena associated with information seeking behavior or intrinsic motivation have also been found to result from cognitive pretraining. These effects appear to relate to the notion that incoming information can be more readily processed and organized as a result of previously acquired cognitive structures (Bieri, 1971; Brody, 1971; Hunt, 1971). Such studies provide a view of cognitive pretraining as a means of functionally enchancing learning through the acquisition of specific mental sets for subsequently taught behaviors.

That effective cognitive pretraining may be accomplished through various instructional media in programmed and other self-instructional formats has also been demonstrated within the context of UPT (Anderson & Hagin, 1971; McCombs, Marco, Sprouls, Eschenbrenner, Reid, 1974; Miller, 1971; Waters, Smith, & Edwards, 1975; Wood & Gerlach, 1974). Specifically, the beneficial effects of mediated cognitive pretraining in ground training for various UPT tasks has been demonstrated in these studies including: (a) a reduction of negative affective responses acting within the individual through a decrease of task load effects, (b) reduction in actual flying time required to attain proficiency in complex perceptual motor skills, and (c) increased student motivation through individualized, self-paced instruction.

The advantages or pretraining, then, as a facilitating mechanism of transfer from cognitive responding to related but more complex psychomotor behaviors are well established. The purposes of the present effort was to investigate cognitive pretraining as a methodology for preparing student pilots as participant/subjects in a UPT study.

III. PRETRAINING OBJECTIVES

For the present research (Investigation of Alternative Instructional Strategies for Basic Instrument Flight Training in the T-40, hereafter referred to as the Alternative Instructional Strategies Study) the scope of pretraining was functional and supportive. It was employed as a method of facilitating the administration and data collection phases of the study.

Since pretraining requirements for this study were extensive, the effort to develop and utilize the pretraining materials as part of the primary experiment became, in a sense, an independent research effort.

The specific purposes for the utilization of cognitive pretraining for the Alternative Instructional Strategies study were as follows: (a) to provide a vehicle for standardized, replicable subject orientation, (b) to permit the training and assessment of specific prerequisite cognitive skills prior to the training of subsequent complex perceptual-motor skills in the trainer/simulator, and (c) to enhance the experimental control of the study.

Standardization. Subjects participating in the Alternative Instructional Strategies Study were all novice student pilots on casual status awaiting entry into the UPT program at Williams AFB, Arizona. The experimental design required that three groups of nine students each make up the comparison groups. The design further required that groups begin pretraining and subsequent data collection activities at one-week intervals. Thus, three separate orientation sessions at one-week intervals were required. Since all instructions to students prior to the data collection were to be equal for all groups, the pretraining package permitted a standardized, replicable means of orienting, training and preassessing subject prerequisite skills.

Cognitive skills training and preassessment. The nature of the task to be trained during the experimental data collection phase of the Alternative Instructional Strategies Study required that a reliable method be developed and implemented to ensure that all subjects had attained specified minimum levels of prerequisite cognitive skills before proceeding to the trainer/simulator phase. An achievement test permitted the assessment of required entry level skills. The training was accomplished by administering to each subject a systematically developed, validated set of instructional materials in the form of a textual training guide manual, video-taped instruction, and a criterion test.

Experimental control. The application of the pretraining materials was intended to permit a degree of experimental control not afforded by less systematized and, therefore, unreplicable orientation techniques. The development of written and recorded training materials permitted precise control over stimulus materials presentation in that all subjects were given identical verbal, written and recorded instructions and materials during the orientation sessions, irrespective of group assignment or time at which entry into the study occurred.

In addition, the pretraining was designed to provide control through facilitating relatively low subject score variability on prerequisite skills achievement tests. A relatively high level of homogeneity, relative to subject performance at the entry level, was sought through the minimizing of achievement test score variance for the prerequisite cognitive skills.

IV. DEVELOPMENTAL APPROACH

The development of the cognitive pretraining materials followed procedures recommended in AFP 50-58, Vol III (Objectives and Tests) and literature from the field of educational technology. The process used to develop the materials was essentially an iterative instructional product development (IPD) cycle based upon criterion-referenced achievement testing.

The remainder of this report describes the methods used and the results obtained in developing, validating, and implementing the pretraining materials as an adjunct or initial phase of the Alternative Instructional Strategies Study.

V. TASK ANALYSIS

A modified task analysis procedure was developed following the general recommendations contained in AFP 50-58, Vol II (Task Analysis). The modification of recommended procedures was made in order to meet the specific requirements of the present study and to develop a set of entry level criteria for the Alternative Instructional Strategies Study.

Working from specifications which had been prepared for each of the maneuvers to be trained in the simulator, an analysis was made relative to skills and knowledges required. It was found generally that sub-elements of maneuver perceptual-motor tasks were either prerequisite cognitive skills or were related directly to prerequisite skills for the execution of the maneuver. For example, one of the to-be-trained tasks required the subject to properly execute a 30° right turn in the simulator. To do this, it was obviously necessary, among other things, for the subject to correctly identify and interpret the movements of the attitude director indicator (ADI). Hence, the reading of the ADI, while constituting a sub-element of the primary task of performing the turn, also became a requisite cognitive skill which could be trained more efficiently and effectively before the student entered the simulator: more efficiently, because of the desirability of providing the student with all prerequisite skills before initiating perceptual motor skill training; more effectively, because of the desirability of precisely controlling the acquisition of prerequisite skills for each participant subject.

As sub-elements began to "fall out" of this analysis procedure, it became evident that many cognitive aspects could be appropriately taught during the pretraining phase of the study, thereby reducing the amount of time in the simulator/trainer devoted to learning of prerequisites. Accordingly, all cognitive elements identified by the analysis, not requiring environmental features of the trainer cockpit were included in the pretraining content.

The analysis of maneuver components yielded ample information concerning the knowledge elements of maneuvers to be learned from which the prerequisite entry behaviors could be logically inferred. Knowledge areas identified as generic to the to-be-trained maneuvers included the following: (a) external forces acting upon an aircraft during various phases of flight, including the analysis of forces by vector diagram and the interaction of vector force combinations; (b) definition and demonstration of steady-state flying conditions, methods of maintaining steady-state, and correcting from deviations from steady-state; (c) analysis of aircraft controls and interactions with force vectors during turns, climbs, descents, and deviations from steady states; (d) identification, reading, and interpretation of the primary cockpit instruments; (e) definition of instrument cross-check and utilization of cross-check for maintaining aircraft control; and (f) integration of areas (a) through (e) in applying knowledge in aircraft control, identifying appropriate aircraft control inputs and/or instrument readings. The above content specifications were subsequently employed to generate a set of instructional objectives.

VI. DEVELOPMENT OF PRETRAINING OBJECTIVES

A list of tentative objectives was generated following procedures recommended in AFP 50-58, Vol III, Mager (1962), and Schutz, Baker, and Gerlach (1971). A revised set of objectives was developed from the tentative objectives representing those cognitive skills considered by the investigators to be foundational to the subsequently taught psychomotor skills. The objectives were designed to assess knowledge of the effects of force vectors upon a maneuvering aircraft (airmanship), identification and reading of various T-40 cockpit instruments, cause-effect relationships between aircraft control inputs, and resultant changes in

aircraft parameters, and instrument crosscheck techniques. A list of pretraining objectives is contained in Appendix A.

VII. CRITERION MEASURE/PRACTICE ITEM DEVELOPMENT

Utilizing the completed list of objectives as a point of departure, a pool of practice and mastery items was generated following procedures adapted from Sullivan, Baker, and Schutz (1971). This pool of items then became the general base from which both a criterion measure and instructional materials could be constructed. Appendix B contains a sample criterion item specification which is indicative of the procedure used for developing criterion items so as to be representative of each training objective.

This procedure is also in accordance with Mager (1973) and is essentially a content domain sampling method in which the instructional intent of each training objective is analyzed and translated into one or more behavioral exercises in which the subject is required to respond in a specified manner to the item(s). It is also a technique which permits control over the content validity of the achievement test through the design redundancy of instructional content/test item relationships. That is, only those items which are representative of the objectives of instruction are included in the test. Conversely, only expository material which directly relates to the objectives is included within the training materials. The order of apparent difficulty of items contained in the achievement test was ranked from less difficult to more difficult in accordance with the recommendations of Ebel (1965). A copy of the validated criterion test is contained in Appendix C.

VIII. INSTRUCTIONAL MATERIALS DEVELOPMENT

The selection of media for the training materials development was based upon the consideration of: (a) administrative flexibility and convenience, and time requirements of the study; (b) the desirability of a self-study vehicle to familiarize subjects with basic concepts and procedures of the data collection; (c) concern for maintaining a high level of standardization of content control over that which was presented to subjects during the pretraining phase of the study; and (d) the instructional requirements of the objectives.

Following analysis of the above requirements, a decision was reached by the instructional developers to utilize an expository teaching approach dividing instructional content between three media formats as follows: (a) basic orientation, scheduling, and administrative directives to subjects to be given by live lecturer as read from previously prepared material (the content of which was to be held to a minimum); (b) self-instructional textual material presenting basic concepts of airmanship and instrument reading; and (c) a video tape demonstrating concepts of aircraft maneuvers and the appearance of aircraft cockpit instruments during maneuvers.

Pretraining guide. Two basic considerations were evident in the planning and development of the pretraining instructional manual. First, it was required that all subjects have adequate amounts of time to learn prerequisite information. Since it was expected that adequate amounts of time would not be available in class, a self-instructional manual was conceived which would allow the student ample time to acquire the basic information. Second, a method was required which would permit a closely controlled of instructional materials presentation.

The textual materials were generated utilizing the instructional objectives and achievement test/practice items pool as a comparison base for the organization and exposition of instructional content. As an example, textual cues corresponding to each of the various instructional objectives were embedded within the expository material of the manual. A modified programmed text format was utilized in which each block of material was followed by several examples or practice items. Each of the items was followed by confirmatory feedback to the learner.

An initial trial draft of the manual was prepared and distributed to members of the scientific staff, assigned to the study, for comments and suggested revisions. Utilizing the obtained suggestions, a revised, edited version of the pretraining manual was prepared. Changes incorporated included content organization

modifications, reconstruction of sentences, revised terminology and spelling changes. A copy of the revised, final version of the pretraining guide is contained in Appendix D.

Videotaped instruction. The video medium was selected as a convenient and efficient means of demonstrating the procedures and concepts which involved aircraft movements, instrument changes during maneuvers and instrument cross-check techniques. Video tape permitted control of stimulus display equivalent to that of the textual materials and also afforded the convenience of repeated identical replay to the various treatment groups.

Following completion of the revised pretraining manual, development of a script for the televised instruction was initiated. The script was generated incorporating the same objectives/mastery item/embedded cue development system technique utilized in the generation of the pretraining guide. The content of the televised material was essentially the same as that of the pretraining guide. Some time was also devoted to review of basic concepts of airmanship and instrument reading as a follow-up and elaboration of materials contained in the pretraining guide. However, emphasis within videotape was upon the visual aspects of the to-be-trained maneuvers.

The television script was written so as to take advantage of the strength of the medium. As concepts and procedures were developed in the script, they were analyzed for visual content, then specifications for the various visual cues in the form of slides and motion pictures were added to the script. During the production of the video tape these specifications were translated into the visual components of the televised presentation. Procedures used in visualizing content followed generally those recommended by Gropper and Glasgow (1971).

The major part of the video taped instruction was made up of 35mm slide and 16mm motion picture footage. Aircraft instruments were shown in extreme close-up 35mm slide views including airspeed, altitude, attitude, vertical velocity and heading indicators to give a clear impression of the function of each. Engine tachometers were also included. The precise markings and exact reading of each indicator were shown in detail and examples of readings were demonstrated. To familiarize subjects with the appearance and action of primary indicators during maneuvers, a 16mm motion picture film sequence was prepared for each of the maneuvers as follows: straight and level flight, 30-degree left bank and turn, 30-degree right bank and turn, wings level constant airspeed climb, and wings level constant airspeed descent. Several film sequences of each maneuver as seen from the pilot's viewpoint were taken. From the raw footage a continuous seven-minute sequence of all maneuvers in chronological order was edited showing the real-time execution of the series as a model demonstration. The edited film sequence was subsequently recorded on video tape as an integral part of the televised instruction. A copy of the videotape script is contained in Appendix E.

The completed video taped instructional unit, then, was produced utilizing a variety of audiovisual elements as expository instructional material for the pretraining effort. The objective of the video taped instruction was to summarize and graphically and pictorially demonstrate the concepts and procedures which were part of the pretraining exercise. The total running time of the completed video tape was 25 minutes, 15 seconds.

IX. VALIDATION OF PRETRAINING MATERIALS

Thirty-one student pilot subjects with no formal undergraduate pilot flying training (casual status awaiting entry into the UPT program) participated in the pretraining materials evaluation data collection. This subject group was representative of the target population selected to participate in the Alternative Instructional Strategies Study.

Product validation criteria. Validation standards for the pretraining materials package were set in accordance with ATC academic criteria, that is, 85 percent correct responses on the test instrument to achieve a satisfactory or passing score. An additional validation criterion was also established specifying that 85 percent of the subjects tested would achieve scores of 85 percent or better on the criterion test as a result of the application of the instructional materials. This latter validation parameter has been recommended for use in the validation of criterion referenced instructional products (Popham & Baker, 1970).

Initial product tryout. Subjects were assembled in a classroom area and given the pretraining manual. They were told that the materials were being considered for use in future pilot training research and that their assistance was needed in helping to improve the materials. Students were asked to make notes and comments in the manual for any part of the content which seemed to be ambiguous or difficult to understand.

Because the application of the pretraining materials within the Alternative Instructional Strategies Study entailed time constraints in which students would have limited classroom time to read the materials, the pretraining manual would be given to students to take home for additional study as needed by the individual. In the product tryout, therefore, participating subjects were also given the manual for take-home reading with the instructions that they were to record the amount of time spent studying the manual outside of class. Subjects were also given 45 minutes of in-class time to read and study the manual.

Subjects were allowed ample time outside of class to complete the reading and study of the pretraining guide before proceeding with other segments of the pretraining phase. The approximate average time reported by subjects in reading the manual outside of class was four hours. Subjects were instructed to read all materials completely and to respond to the practice items and questions in the manual since these items were to be considered preparation for the criterion test. They were also instructed to report any difficulties encountered in understanding the materials by noting problems in the manual. All subjects verified that they had completely read the instructional manual prior to the next class period.

The next class period was devoted to followup instruction and testing. The subjects were first shown a 25-minute video tape demonstration of airmanship, flight instrument readings, and control inputs to the aircraft for each of the specific flying maneuvers to be trained in the simulator/trainer. Immediately following the videotape, the subjects were given a 25-item, multiple choice criterion test.

The criterion test was administered to the entire 31-subject group simultaneously through the use of two slide projectors. The stem of each multiple choice question was presented on the left half of the projection screen and the alternative responses were flashed on the right half of the screen. In most of the questions, the stem contained line drawings of aircraft or pictures of cockpit indicators to which the student was required to utilize to make his response. Each subject was given a standard ATC multiple choice test answer sheet upon which to record his selected responses. As each test item was presented, time was allowed for all subjects to respond to the item before continuing to the next item.

The 35mm slide medium for displaying test items in the classroom was selected because of time and cost advantages afforded in preparing the test over conventional test booklets and also because of the improved visual detail afforded to viewer.

All subjects were able to complete the 25-item criterion test in the allotted class time of one hour. Following the completion of the testing, answer sheets were collected.

Results of pretraining materials tryout. The raw score mean obtained on the 25-item criterion measure for the 31-subject group materials validation was 20.13 with a standard deviation of 2.61. Obtained scores thus fell substantially below the specified criterion. The range of scores for this sample was from 56 to 96 percentage points (mean = 80.52, S.D. = 10.57) with only 56 percent of the subjects attaining test scores of 85% or better. Materials revision was, therefore, required.

Test reliability. Measure of the reliability of the criterion test were made following the collection and analyses of raw scores. A split-half reliability coefficient of .76 was obtained utilizing the odd-even item dichotomy. Employing the Spearman-Brown prophesy formula for small item sample criterion tests to project the measure to a 50-item equivalence, a reliability estimate coefficient of .91 was obtained.

Revisions. The item analysis revealed that four of the 25 items in the test required revision. In examining the items and reviewing related instructional materials content, the nature of the revisions became apparent. For example, several of the items contained ambiguous terminology and meanings. Repair of instruction was made by either revising the item or revising the content of the instructional materials so that ambiguities were removed. A general re-reading and correlation of instructional materials with test items was also performed to insure that specific cues embedded within textual and video tape materials were relevant to test items and vice versa, and also to insure that irrelevancies were deleted.

Objective relevant instructional cues and mastery items were considered part of the domain-sampling technique used in the generation of original test items and instructional materials. Hence, the effort to revise materials and test items following the initial tryout represented a method of "tightening" cues and test items.

An additional five items were added to the criterion test bringing the total number of items to 30. This was done to include items on instrument cross check procedures which had been omitted from the original version of the test and also to strengthen the reliability of the test by increasing the number of items.

A major format change was also made in the administration of the test. In the first tryout, as previously explained, the test was administered via a dual projection system on which the experimenter displayed questions on the screen. In assessing feedback about the test, it was found that some subjects objected to the projection technique. Some felt that a "lock-step" effect was produced and that negative feelings resulted because of the press to complete test items so as not to delay the group.

Although it had originally been conceived as a cost effective method for test administration, the projection technique was abandoned and the achievement test was prepared in a test booklet format. Each of the test items requiring pictorial representations of aircraft instruments was reconstructed for the booklet to include black and white glossy photographs of the instruments. No content changes in the test (as revised) were made. A completed master copy of the test was prepared with illustrations and reproduced in multiple copies.

Several revisions were made in the instructional materials. These were primarily of a technical nature. For example, the video taped instruction was re-recorded utilizing a film sequence of improved visual quality. Several minor additions were also made in the narrative of the video tape to improve the clarity and flow of the presentation. A revised version of the training guide booklet was produced with improved pictorial quality.

Final validation. Final product evaluation of the pretraining materials consisted of administering the pretraining package to the first group of nine subjects assigned to the Alternative Instructional Strategies Study from casual status. The use of this group, rather than a separate group not involved in the study was made for the following reasons: (a) there were time constraints in the start date of the Alternative Instructinal Strategies Study, (b) a sufficient number of subjects from the target population (casuals) was not available at a time convenient for further validation of materials.

Procedures. Subjects were assembled in the classroom on a Friday afternoon and given verbal instructions by the experimenter. These instructions were minimal and in written format so that they would be identical for all groups. Following the brief instructions, subjects were given copies of the pretraining guide booklet and told that they would have until the following Monday morning class time to study the booklet and complete the self-test contained in the booklet. Subjects were encouraged to complete as much of the booklet as possible during the remainder of the class time for the day which was approximately 45 minutes.

The following Monday morning subjects were again assembled in the classroom. They were allowed 10 minutes to review information contained in the pretraining guide and then they were shown the 25-minute revised video tape on a classroom video monitor. Immediately following the conclusion of the video-taped instruction, copies of the revised achievement test booklet and answer sheets were distributed to all subjects. They were allowed as much time as they required to complete the 30-item test.

Results. Table 1 presents comparative data for the first and second product tryouts. A Behrens-Fisher t' test (Winer, 1962) for unequal n's was calculated to test the differences between the obtain mean scores for the first and second product tryouts. As the table indicates, student performance on the achievement test was significantly ($p < .01$) improved on the second tryout utilizing the revised pretraining materials as compared to the performance of subjects using the earlier version of the materials.

Table 1. **Student Achievement on Criterion Measure: First and Second Pretraining Materials Tryouts Compared**

Group	N	Raw Scores			Percentile Scores	
		Range	Mean	SD	Mean	SD
First Tryout	32	24–14*	20.13	2.61	80.5	10.57
Second Tryout	9	30–24**	27.77	2.19	92.59**	7.33

*25-item test.
**30-item test.
**p<.01.

As shown in Table 1, the mean raw score for the second tryout group was 92.59 on the revised 30-item criterion test, well above the 85 percent minimum standard. All but two subjects achieved scores exceeding the 85 percent standard.

X. IMPLEMENTATION AND EVALUATION OF PRETRAINING MATERIALS FOR THE ALTERNATIVE INSTRUCTIONAL STRATEGIES STUDY

Following the final validation of the pretraining package, the materials were administered to the remaining two experimental groups at one-week intervals in accordance with the scheduled study. Identical materials and procedures (as used for the first groups) were used for the remaining two groups.

Results of the administration of the pretraining materials to the three groups of subjects (N=27) who were involved in the Alternative Instructional Strategies Study are reported in Table 2. Inspection of the data reveals a consistency and similarity across groups on achievement test performance. Data for groups two and three essentially replicate those obtained for the first group (second product tryout group) with statistically non-significant differences between group mean scores for the three groups obtained.

Table 2. **Training Product Evaluation: Student Achievement on Criterion Measure for 1123-02-20 Pretraining**

Group	N	Raw Scores			Percentile Scores	
		Range	Mean	SD	Mean	SD
First	9	30–24	27.77	2.19	92.59	7.33
Second	9	30–26	28.	1.33	93.4	4.46
Third	9	30–25	27.88	1.37	92.8	4.59
All	27	30–24	27.88	1.61	92.93	5.39

The variance of test scores across the groups is also noteworthy. One of the objectives of the pretraining phase, to review, was to bring subjects to specified levels of performance on prerequisite skills and to reduce the variability of scores within the group. The obtained standard deviations are indicative of the generally low group variance on the achievement as a result of cognitive skills training.

Direct comparisons of student performance with the prespecified product validation criteria showed that performance for the three groups combined exceeded the target criteria of an 85 percent score or better for 85 percent of the subjects tested, that is, 24 of the 27 subjects (90%) in the three groups achieved scores of 85 percent or better on the test.

The above outcomes serve to reinforce inferences concerning the validity of the pretraining materials as developed and tested.

To assess the reliability and validity of the test, two additional measures were computed. An odd-even item reliability coefficient (split-half) of .97 was obtained for the 30-item test. Using procedures involving the use of the reliability coefficient (Noll & Scannel, 1972), the standard error of measurement of the test was completed at .36 percentile points.

Taking the standard error of measurement as an indication of the confidence that may be placed in the accuracy of individual test scores, this value shows less than a percentage point between the two scores for any individual score at the .05 confidence level. In other words, for a student scoring about the mean, say 93, it may be inferred that 95% surety that his true score lies between 92.64 and 93.36, representing a relatively low degree of measurement error.

To summarize, the instructional materials used for the Alternative Instructional Strategies Study achieved the objectives and criteria established for the cognitive pretraining phase of the study. Subjects were brought to acceptable levels of cognitive skill as defined by validation criteria. Variability of groups scores was generally low and reliability of test scores and the criterion reliability were relatively high.

XI. CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates that cognitive pretraining can be a valuable adjunct to experimental study methodology. It shows that systematically developed, validated instructional materials aid in the conduct and administration of experimental data collection by bringing learners to prespecified levels of attainment on prerequisite skills. The study also demonstrates that use of training materials in several media formats provides a useful and effective technique for standardizing and expediting the orientation of participants subject.

Potential applications of pretraining for experimental research appear to be wide range. The implementation of a variety of self-instructional media with systems designed instruction would appear to afford administrative convenience, operational flexibility, and improved control over pre-training of subjects for appropriate experimental designs.

The results of the present effort strongly suggest the desirability of additional investigations which go beyond the scope of pretraining as an orientation technique. At least two areas of investigation are presently identifiable: (a) investigations of pretraining within the context of experimental designs in which differential pretraining and pretesting are used for subsequent assignment of subjects to treatment groups, and (b) investigations in which the differential effects of instructional variables as pretraining strategies are measured in relationship to those variables under investigation in the training study itself.

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APPENDIX A: PRETRAINING OBJECTIVES

1. Given diagrams of turning aircraft with vectors drawn to indicate forces acting upon the aircraft, identify each diagram as climbing, descending, or maintaining level flight.

2. Given a list of factors affecting aircraft performance during flight, some of which do and do not affect the turning ability of an aircraft, identify those who affect turning ability of the aircraft.

3. Given a list of factors affecting aircraft performance during flight, identify those which cause the aircraft to lose altitude during a turn.

4. Given pictorial representations of each of six T-40 cockpit instruments, i.e., airspeed indicator, vertical velocity indicator, heading indicator, altimeter, attitude indicator and tachometer, in which the displays of each instrument represent specific parameter values, tell what the correct reading for each instrument is, within +5 percent of the true parameter value represented.

5. Given a pictorial representation of the T-40 cockpit instrument panel, identify: (1) the altimeter, (2) the airspeed indicator, (3) vertical velocity indicator, (4) attitude indicator, (4) heading indicator and (5) tachometer.

6. Given a variety of flight parameter values, name the appropriate indicator instrument through which the parameter value will be represented in flight on the instrument panel.

7. Given line illustrations of a T-40 aircraft varying in roll, pitch, and heading, the student will identify the illustration that best represents the position of the aircraft on an illustration of an attitude indicator and a heading indicator.

8. Given a diagram of the T-40 instrument panel and a list of crosscheck procedures, indicate the proper order in which the procedures should occur.

9. Given a diagram of the instrument panel showing indicators in specific value readings, a description of a desired change in a specific parameter, and a list of aircraft control inputs, some of which are and are not appropriate for affecting the desired change, identify the appropriate alternative.

APPENDIX B: SAMPLE CRITERION ITEM TABLE OF SPECIFICATIONS

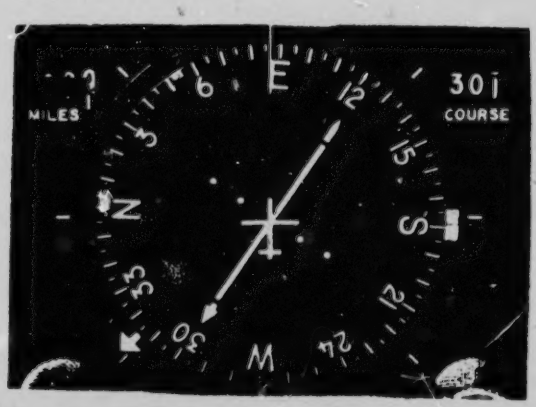
Objective:

1. Given:
   a. Picture of T-40 primary instruments showing specific in-flight parameter values -
   b. Verbal descriptions of desired changes in one or more parameters -
   c. Verbal descriptions of aircraft control inputs which may affect parameter value changes -
2. Response: Identify the appropriate input corresponding to the described desired change.
3. Response mode: Select correct response by marking paper with pencil.

Sample Mastery Item:

1. Given:

DESIRED READING: HEADING 360°



2. Response Choices:
   A. TURN LEFT APPROXIMATELY 96°
   B. TURN RIGHT APPROXIMATELY 86°
   C. TURN LEFT APPROXIMATELY 86°
   D. TURN RIGHT APPROXIMATELY 230°

Response Limits:

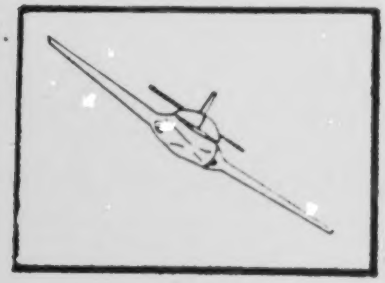
Correct: All responses which will affect the desired change as described in the item.

Incorrect: All plausible but erroneous inputs which appear to affect but will not affect the desired change.

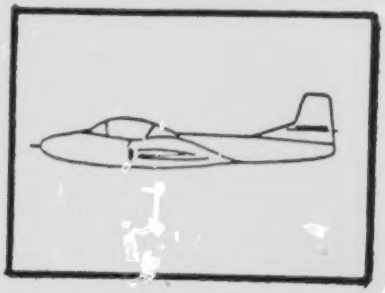
APPENDIX C: T-40 INSTRUCTIONAL STRATEGIES
CRITERION MEASUREMENT

1. WHICH AIRCRAFT IS IN A LEVEL TURN TO THE LEFT?

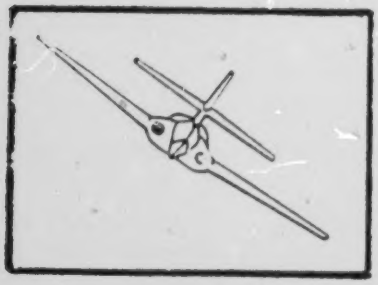
A.



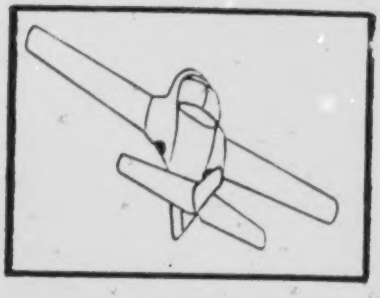
C.



B.

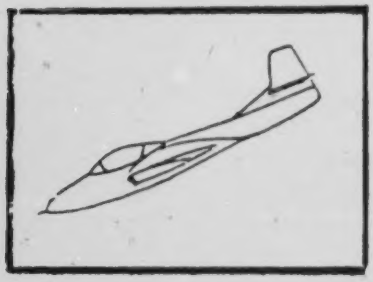


D.

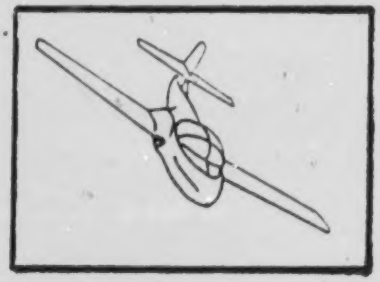


2. WHICH AIRCRAFT IS IN A CLIMB TO THE RIGHT?

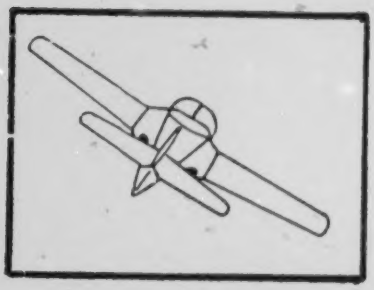
A.



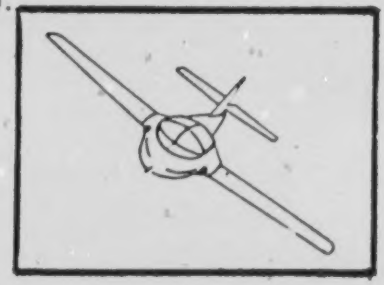
C.



B.

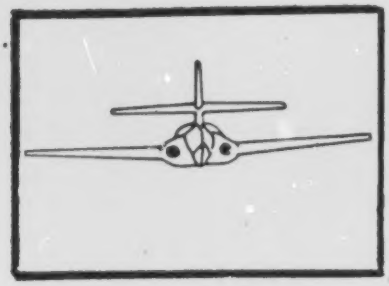


D.

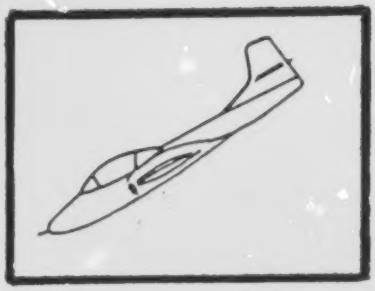


3. WHICH AIRCRAFT IS IN LEVEL FLIGHT?

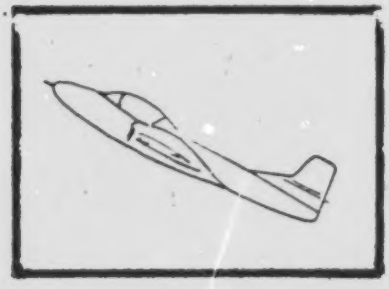
A.



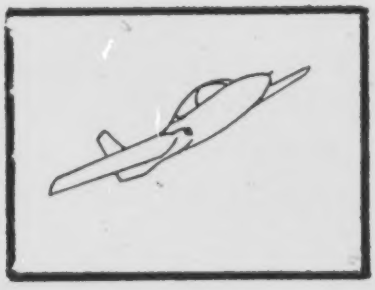
C.



B.

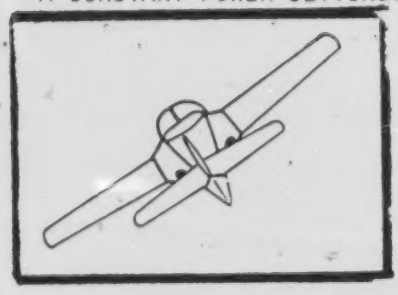


D.

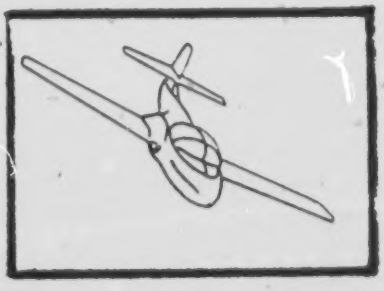


4. WHICH AIRCRAFT WILL ATTAIN THE GREATEST AIRSPEED WITH A CONSTANT POWER SETTING?

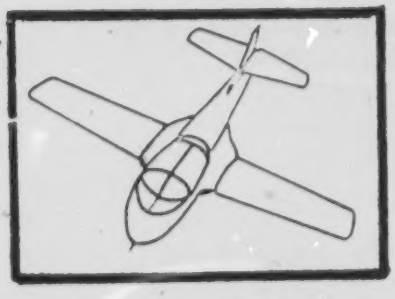
A.



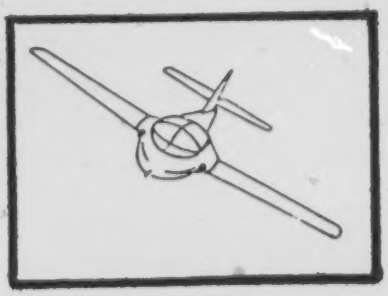
C.

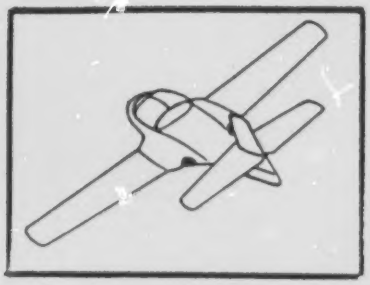


B.



D.



5. 

5. WHAT IS THE FLIGHT ATTITUDE OF THIS AIRCRAFT?

   A. LEFT CLIMB.

   B. STRAIGHT AND LEVEL.

   C. SHALLOW LEVEL CLIMB.

   D. RIGHT DESCENT.

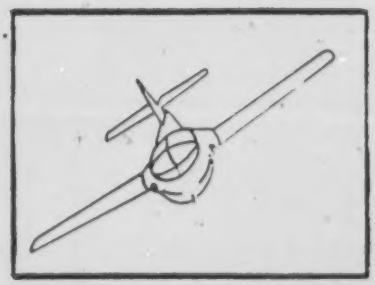
6. WHAT ARE THE BASIC CONTROL INPUTS TO RETURN THE AIRCRAFT IN QUESTION 5 TO STRAIGHT AND LEVEL?

   A. YOKE LEFT AND AFT.

   B. YOKE LEFT AND FORWARD.

   C. YOKE RIGHT AND AFT.

   D. YOKE RIGHT AND FORWARD.

7. 

7. WHAT IS THE FLIGHT ATTITUDE OF THIS AIRCRAFT?

   A. LEFT CLIMB.

   B. STRAIGHT AND LEVEL.

   C. SHALLOW LEVEL CLIMB.

   D. RIGHT DESCENT.

8. WHAT ARE THE BASIC CONTROL INPUTS TO RETURN THE AIRCRAFT IN QUESTION 7 TO STRAIGHT AND LEVEL?

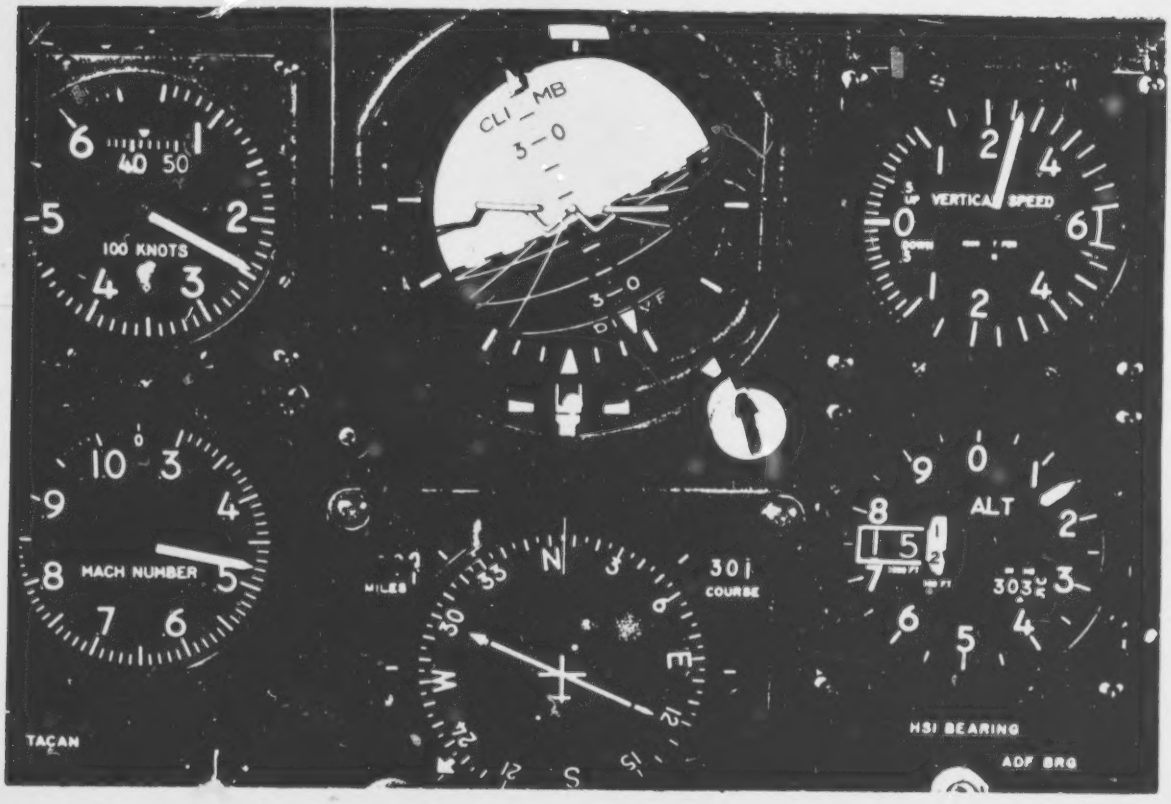
   A. YOKE LEFT AND AFT.

   B. YOKE LEFT AND FORWARD.

   C. YOKE RIGHT AND AFT.

   D. YOKE RIGHT AND FORWARD.

REFER TO THE INSTRUMENT PANEL BELOW FOR QUESTIONS 9-13.



9. WHAT IS THE AIRSPEED?

   A. 142 KNOTS.

   B. 142 MPH.

   C. 242 KNOTS.

   D. 242 MPH.

10. WHAT IS THE ALTITUDE?

   A. 5,150'

   B. 151,500'

   C. 150'

   D. 15,150'

11. WHAT IS THE HEADING?

A. 006°

B. 366°

C. 300°

D. 301°

12. WHAT IS THE VERTICAL VELOCITY?

A. 260 FPM

B. 260 MPH

C. 2600 MPH

D. 2600 FPM

13. WHAT IS THE BANK ATTITUDE?

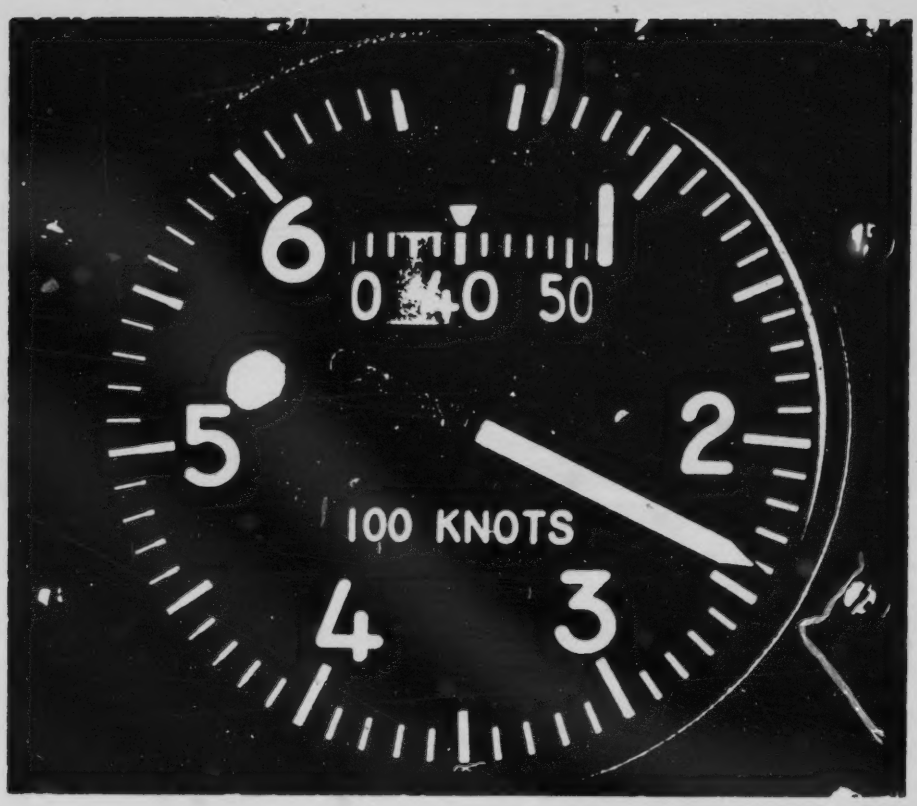
A. 28° LEFT.

B. 5° NOSE HIGH.

C. 28° RIGHT.

D. 10° NOSE HIGH.

FOR QUESTIONS 14-17 READ THE INSTRUMENT DISPLAY AND SELECT THE ANSWER WHICH BEST DESCRIBES THE CONTROL INPUTS TO REGAIN THE DESIRED READING. DO NOT CONSIDER THE EFFECT YOUR CHOICE WOULD HAVE ON OTHER INSTRUMENTS.



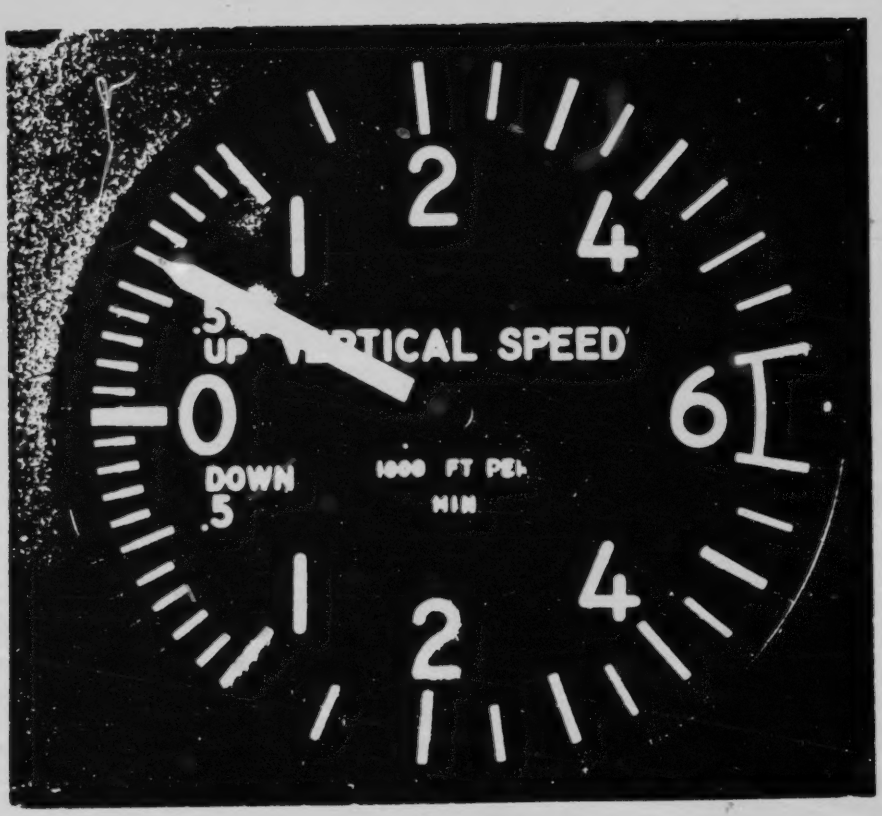
14. DESIRED READING: 250K

A. INCREASE RPM ONLY

B. INCREASE RPM AND/OR DESCEND

C. DECREASE RPM ONLY

D. DECREASE RPM AND/OR DESCEND



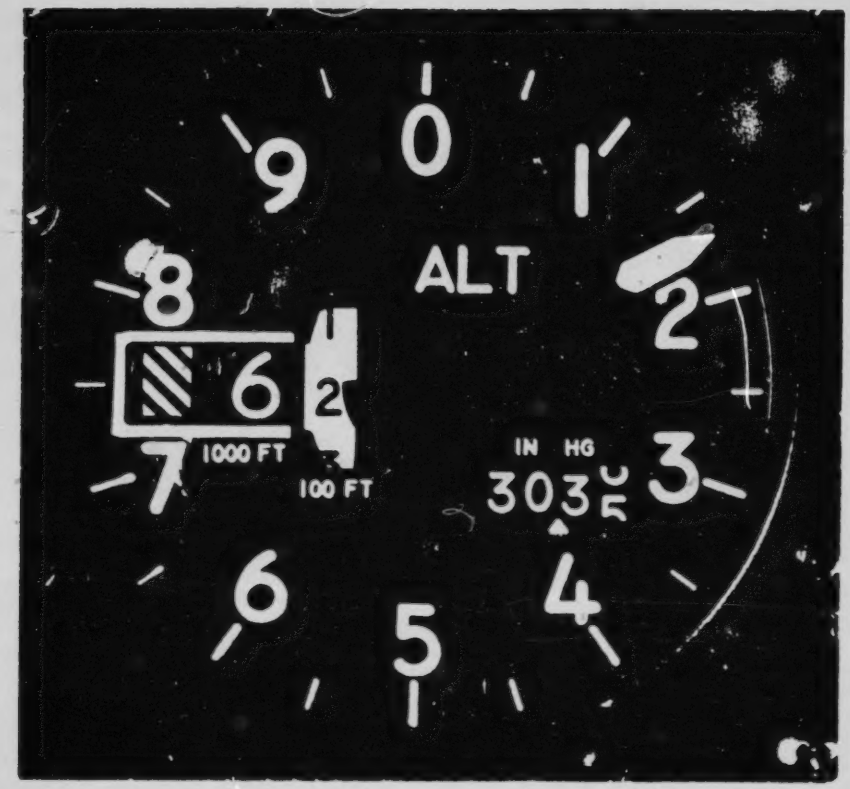
15. DESIRED READING: ZERO VERTICAL VELOCITY

A. DECREASE PITCH

B. INCREASE RPM

C. DECREASE RPM

D. INCREASE PITCH



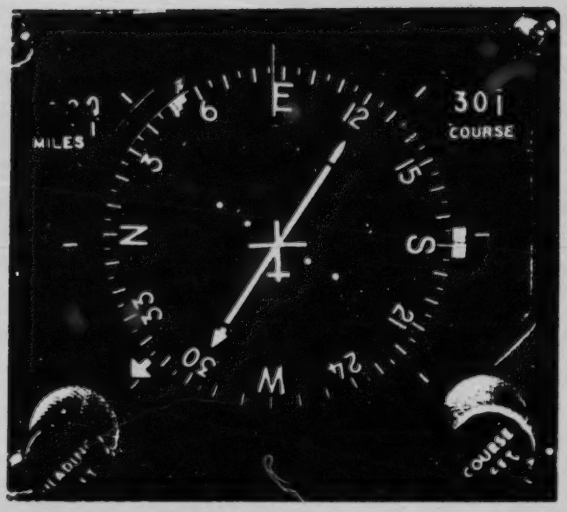
16. DESIRED READING: 15,000'

A. CLIMB APPROXIMATELY 1,170'

B. DESCEND APPROXIMATELY 8,830'

C. CLIMB APPROXIMATELY 8,830'

D. DESCEND APPROXIMATELY 1,170'



17. DESIRED READING: HEADING 360°

A. TURN LEFT APPROXIMATELY 96°

B. TURN RIGHT APPROXIMATELY 86°

C. TURN LEFT APPROXIMATELY 86°

D. TURN RIGHT APPROXIMATELY 230°

18. THE APPROXIMATE PITCH ATTITUDE FOR A CONSTANT AIRSPEED CLIMB IS _____ NOSE HIGH.

A. 1^{o}

B. 2^{o}

C. 3^{o}

D. 4^{o}

19. WHICH ANSWER BEST DESCRIBES THE ENTRY TO A NORMAL LEFT TURN?

A. INCREASE PITCH SLIGHTLY, THEN ROLL INTO 30^{o} LEFT BANK ON THE ATTITUDE INDICATOR, INCREASE RPM SLIGHTLY.

B. INCREASE RPM SLIGHTLY, THEN INCREASE PITCH SLIGHTLY, THEN ROLL INTO 30^{o} LEFT BANK ON THE ATTITUDE INDICATOR.

C. ROLL INTO 30^{o} LEFT BANK ON THE ATTITUDE INDICATOR, THEN INCREASE PITCH SLIGHTLY, THEN INCREASE RPM SLIGHTLY.

D. ROLL INTO 30^{o} OF LEFT BANK ON THE HEADING INDICATOR, THEN INCREASE RPM SLIGHTLY, THEN INCREASE PITCH SLIGHTLY.

20. WHICH ANSWER BEST DESCRIBES THE EXIT (ROLLOUT) FROM A NORMAL 30^{o} BANK TURN?

A. BEGIN ROLLOUT 30^{o} PRIOR TO DESIRED HEADING WITH EMPHASIS ON THE ATTITUDE INDICATOR DURING ROLLOUT.

B. BEGIN ROLLOUT 30° PRIOR TO DESIRED HEADING WITH EMPHASIS ON THE HEADING INDICATOR DURING ROLLOUT.

C. BEGIN ROLLOUT 10° PRIOR TO DESIRED HEADING WITH EMPHASIS ON THE HEADING INDICATOR DURING ROLLOUT.

D. BEGIN ROLLOUT 10° PRIOR TO DESIRED HEADING WITH EMPHASIS ON THE ATTITUDE INDICATOR DURING ROLLOUT.

21. WHICH ANSWER BEST DESCRIBES THE ENTRY TO A CONSTANT AIRSPEED CLIMB?

A. SLOWLY RAISE THE NOSE WHILE SIMULTANEOUSLY INCREASING RPM TO FULL POWER.

B. INCREASE RPM TO FULL, THEN RAISE THE NOSE.

C. SLOWLY RAISE THE NOSE TO AN APPROXIMATE PITCH, THEN INCREASE RPM TO FULL.

D. SLOWLY RAISE THE NOSE WATCHING THE VERTICAL VELOCITY WHILE SIMULTANEOUSLY INCREASING RPM TO FULL.

22. WHICH ANSWER BEST DESCRIBES THE EXIT (LEVEL OFF) FROM A CONSTANT AIRSPEED DESCENT?

A. BEGIN LEVEL OFF PRIOR TO DESIRED ALTITUDE USING 200' OF LEAD.

B. BEGIN LEVEL OFF PRIOR TO DESIRED ALTITUDE USING A LEAD POINT EQUAL TO 10% OF THE VERTICAL VELOCITY.

C. BEGIN LEVEL OFF PRIOR TO DESIRED ALTITUDE USING 100' OF LEAD.

D. BEGIN LEVEL OFF AT DESIRED ALTITUDE AND CLIMB BACK TO DESIRED IF NECESSARY.

23. IN A CONSTANT AIRSPEED DESCENT ON A HEADING, WHICH PARAMETER IS VARIED AS NECESSARY?

A. PITCH

B. POWER

C. HEADING

D. AIRSPEED

24. THE RECOMMENDED LEAD POINT FOR ROLLING OUT OF A TURN IS _____ AND IS LOCATED ON THE _____.

A. 10^{o}; ATTITUDE INDICATOR

B. 1/3 THE ANGLE OF BANK; HEADING INDICATOR

C. 1/3 THE ANGLE OF BANK; ATTITUDE INDICATOR

D. 20^{o}; HEADING INDICATOR.

25. THE RECOMMENDED LEAD POINT FOR A LEVEL OFF IS _____ AND IS LOCATED ON THE _____.

A. 200'; VERTICAL VELOCITY INDICATOR.

B. 10% OF VERTICAL VELOCITY; ATTITUDE INDICATOR.

C. 200'; ALTIMETER.

D. 10% OF VERTICAL VELOCITY; ALTIMETER

26. IF YOUR ALTITUDE IS 500' BELOW DESIRED, WHAT IS THE RECOMMENDED VERTICAL VELOCITY TO PERFORM A CORRECTION BACK TO DESIRED.

A. 1000 FPM CLIMB.

B. 1000 FPM DESCENT.

C. 500 FPM CLIMB.

D. 500 FPM DESCENT.

27. THE DESIRED HEADING IS 090^{o}. THE ACTUAL HEADING IS 075^{o}. TO CORRECT BACK TO DESIRED, TURN _____ USING _____ BANK.

A. RIGHT; 30^{o}.

B. LEFT; 30^{o}.

C. RIGHT; 15^{o}

D. LEFT; 15^{o}

28. DEVIATIONS FROM AIRSPEED IN A LEVEL TURN ARE NORMALLY CORRECTED WITH _____.

A. PITCH.

B. BANK.

C. POWER.

D. CROSSCHECK.

29. THE TWO BASIC TYPES OF CROSSCHECK AS EXPLAINED IN THE PRETRAINING GUIDE ARE _____ AND _____.

A. RHYTHMIC SCAN; ACCENTUATED.

B. CENTRALIZED; RHYTHMIC SCAN.

C. CENTRALIZED; PATTERNED.

D. ACCENTUATED; PATTERNED.

30. YOUR CROSSCHECK WILL CENTRALIZE WHEN:

A. IN A STEADY STATE CONDITION.

B. IN AN ENTRY TO A MANEUVER.

C. CORRECTING FOR A DEVIATION.

D. BOTH B AND C.

APPENDIX D

AIR FORCE HUMAN RESOURCES LABORATORY

T-40 INSTRUCTIONAL STRATEGIES PRETRAINING GUIDE

Flying Training Division
Williams Air Force Base, Arizona 85224

AIR FORCE SYSTEMS COMMAND

BROOKS AIR FORCE BASE, TEXAS

PRETRAINING GUIDE

General

I. OBJECTIVE: To investigate the effects of alternative flight training instructional strategies upon learning and transfer of training under conditions of task loading.

II. INTRODUCTION: You will be participating in a flight training study conducted by the Air Force Human Resources Laboratory, Flying Training Division, Williams AFB, AZ. You will receive four flights in the T-40. Due to the criticality of data collection and scheduling, you will be in a very controlled environment. It will be each individual subject's responsibility to assure attendance for all briefings and trainer flights. All briefings and training will be conducted in the AFHRL Building P-558, at Williams AFB, located near the corner of First Street and D Street. You will be given a tentative schedule including briefings and flight times. Any changes to your schedule will be passed on to you as early as possible for your convenience, however, unavoidable last minute changes may occur in the event of equipment failure. In the latter case, it will be very important that you try to adjust your time if at all possible.

III. PRETRAINING GUIDE SEGMENTS (PG):

A. Narrative Description: The PG is the narrative description of the training device (T-40), basic principles of flight, a discussion of attitude instrument flying, and a description of the five flight maneuvers you will be taught. You will be expected to read the entire PG prior to the first trainer lesson. There may be some areas you won't understand. If this is the case, make a note of your questions

and present them to your instructor during the preflight briefing of your first flight.

B. Preflight Briefing: The first lesson will be one hour, twenty minutes (1+20) to include a 30-minute preflight brief about the lesson maneuvers and the T-40. It will be conducted by your instructor pilot (IP) immediately prior to lesson (hereafter referred to as sortie) one. This is the time to ask your questions about the PG.

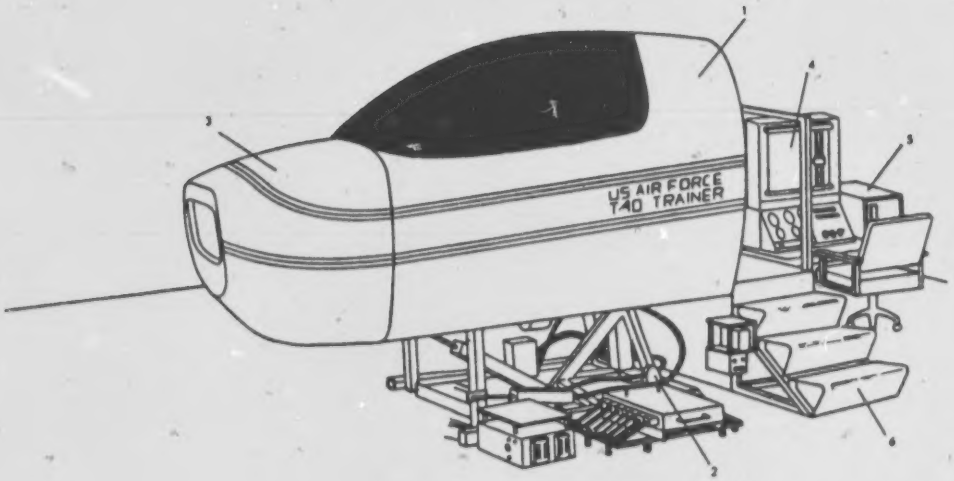
C. Flight Maneuvers: You will be given instruction on five basic instrument maneuvers: straight and level flight, 30° bank turns to the left and right to heading, and constant airspeed climbs and descents. These maneuvers are designated A-E respectively.

D. Critique: You will receive a critique to be filled in at the completion of your training. We ask that you be objective and candid in your responses.

Pretraining Guide

I. T-40: The Instrument Flight Trainer, Type A/F37A-T40 is designed to train flight personnel in the cockpit environment of a typical utility twin-engine jet aircraft. The purpose of the trainer is to provide a high degree of training in instrument flight, radio communication, navigation, and engine systems for this type of aircraft.

The trainer (Figure 1a) consists of a cockpit shell mounted on a two-degree-of-freedom motion system, a hydraulic pump unit, and an instructor station. The nose section of the cockpit contains power supplies and components of the solid-state hybrid computer, and the flight compartment resembles a functional environment of pilot and copilot stations. The hydraulic pump unit that supplies hydraulic power to the



1. Cockpit Assembly
2. Motion Base
3. Nose Section (Computer, Power Supply)
4. Instructor Console
5. Card Reader
6. Stairs Installation

Instrument Flight Trainer, Type A/F37A-T40

Figure 1a. T-40

motion system and control loading system is located beneath the stairs platform at rear of the cockpit. Located on a desk external to the cockpit is the instructor station. All these major components are extensively interfaced to provide maximum utilization of the trainer's capabilities.

The interior of the flight compartment, including the controls, instruments, equipment, and furnishings, is typical of the aircraft represented. Two seats with upholstered backs, cushions, and seat belts are provided for the pilot and copilot stations. Seat adjustments are included for raising, lowering, and longitudinal control. Center

pedestal panels are located between the two seats. A jump seat for an instructor/observer is located behind the copilot seat.

A hydraulically powered control loading system provides realistic control feel in the two primary modes of flight control (longitudinal and lateral).

The two-degree-of-freedom motion system provides kinesthetic sensations to the flight crew, similar to those experienced in real flight, but limited in magnitude and period of sustainment by the limitations of the hardware and motion envelope. The performance of the system is such that trainer movement gives correct and realistic cues to the flight crew in all normal and abnormal maneuvers. The trainer is imperceptively returned to a level position as soon as the conditions causing accelerations return to neutral. The motion system is capable of providing motion in the pitch and roll axes. The pitch motion also provides vertical translation at the pilot's center of gravity to simulate a third axis cue.

Entry and exit to and from the simulator will be explained as you enter for the first sortie. Operation of the controls and cockpit equipment will be covered by your IP during the preflight briefing and during sortie one. Figure 1b is a display of the cockpit and instrument panel layout.

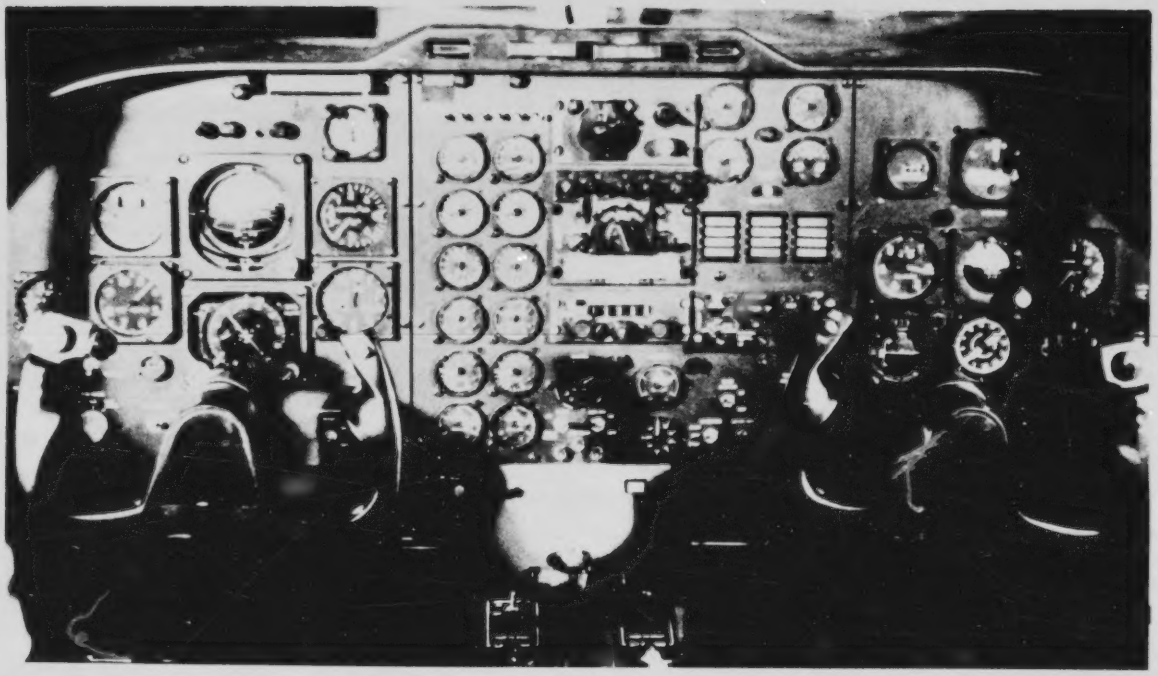


Figure 1b. Cockpit Layout

The primary consideration held above the objective of the study is safety for individuals and equipment. In the interest of safety, we require timely compilance with all instructions related to the use of the equipment in the trainer bay. There are numerous caution and warning signs posted in the building. Please take note of them when you're in the building.

II. BASIC PRINCIPLES OF FLIGHT

A. Lift vs Weight: Lift (L) is a direct result of the relationship between air and the moving aircraft. When an aircraft is moving through the air at a constant airspeed, a differential pressure is formed on

the wing resulting in an upward force measured in pounds. If an aircraft weighs 6000 lbs, the wings must generate 6000 lbs of lift to maintain level flight. Since the pilot cannot directly control weight (W), he must control lift to balance the forces for level flight. This is done by moving the control yoke forward or aft to generate or destroy lift. Figure 2 shows the side view of an aircraft in level flight labeled with basic force vectors.

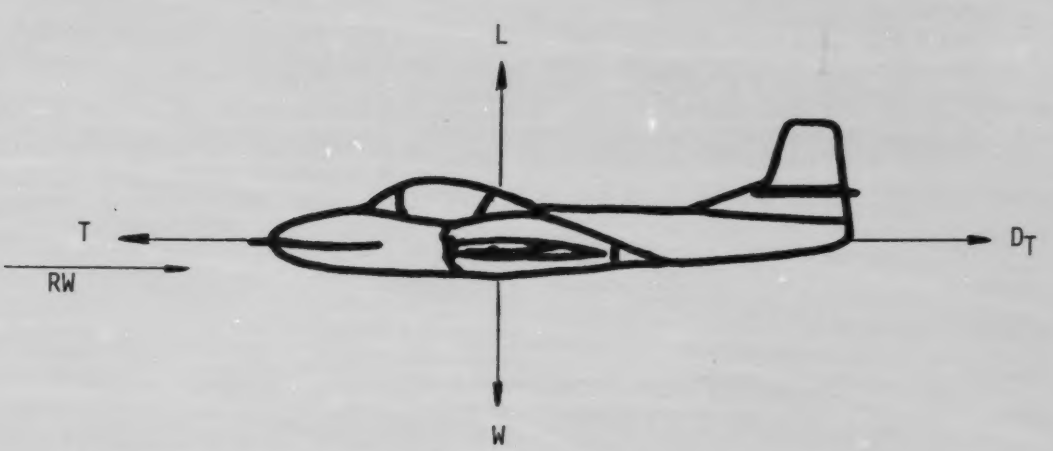


Figure 2. Straight and Level Flight

Weight always acts perpendicular to the surface of the earth. Lift always acts perpendicular to the longitudinal and lateral axes. In level flight at a cruise airspeed, the lift and weight vectors are

basically equal and opposite. In reality, lift is composed of two components: the vertical component (L_v) and the horizontal component (L_h). In Figure 2 L_v is coincidental with L. Therefore, L_h = zero.

B. Thrust vs Drag: Thrust (T) is the force generated by the engines to propel the aircraft through the air to generate lift. Drag (D_t) is the force acting on the aircraft to slow it down. When the two are equal the aircraft maintains a constant airspeed. The relative wind is the flow of air opposite to the flight path of the aircraft. It is as if the aircraft never moved but a strong wind blew over the wings. Thrust is controlled directly by the pilot through the throttles. Drag, for the purposes of this study only, is not directly controllable by the pilot.

Drag is composed of two types: Induced drag (D_i) and parasite drag (D_p) which when added together equals total drag (D_t). Whenever lift is produced, D_i is produced proportionately, as a by-product. At a constant airspeed in level flight D_i is a constant. D_p is simply a result of the friction of the air on the surface of the aircraft and for purposes of this study will always be constant. Therefore, in level flight total drag (D_t) is changed with changes in lift controlled by the pilot. Figure 2 shows the thrust and drag vectors.

C. Turning Flight. When a turn is desired, the aircraft must be rolled into a bank (normally 30°) and stabilized. If the airspeed is constant, lift will not change. But in a banked attitude, lift is not directly opposing weight. L_v now must oppose weight. To make L_v = W, lift must be increased by pulling back a slight amount on the yoke. When L_v = W, the forces that keep the aircraft in a level turn are balanced.

In a bank, L_h is also produced. This force turns the aircraft. Figure 3 shows a rear view of an aircraft in a turn to the left labeled with the lift vector and its component vectors.

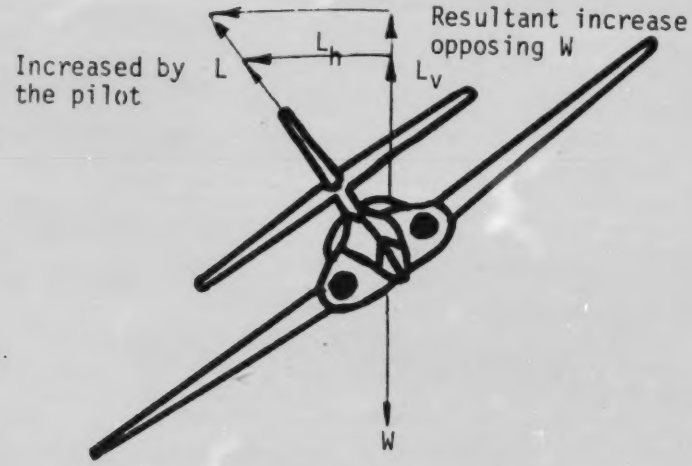


Figure 3. Left Turn (Rear View)

When the pilot pulls back on the yoke to increase lift so $L_v = W$, D_i is generated. With this increase in total drag, thrust will have to be increased enough to balance T and D_t and maintain airspeed.

In summary, to maintain a level turn at a constant airspeed, the yoke must be pulled back and the power increased slightly. Too much/little back pressure or too much/little power will not properly balance the forces and cause the aircraft to deviate from stable conditions;

i.e., too much back pressure in a turn will cause the aircraft to climb.

D. Climbing Flight: When a climb is desired, the pitch attitude will have to be increased some estimated amount to change the flight path from straight ahead to upward.

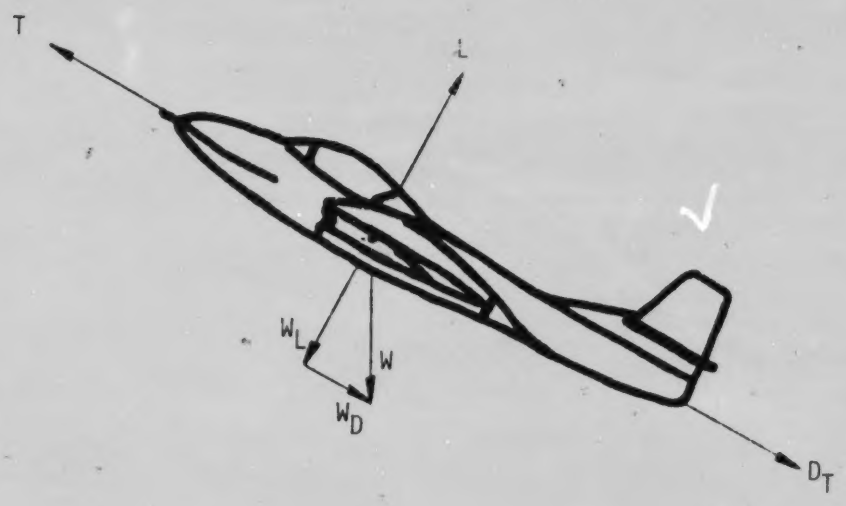


Figure 4. Level Climb

If it is desired that the power be increased to the maximum, the pitch attitude of the aircraft will be the factor that controls a constant airspeed. In a climb, weight converts to two components: the component opposing lift (W_L) and the component supplementing drag (W_D). Since thrust is increased some measured amount, W_D will have to be increased enough to make the new D_t = T. Changes in pitch will change W_D. Keeping

the airspeed constant is the only way the pilot knows the forces are balanced (see Figure 4).

E. Descending Flight: When a descent is desired the pitch must be decreased some estimated amount to change the flight path from straight ahead to downward.

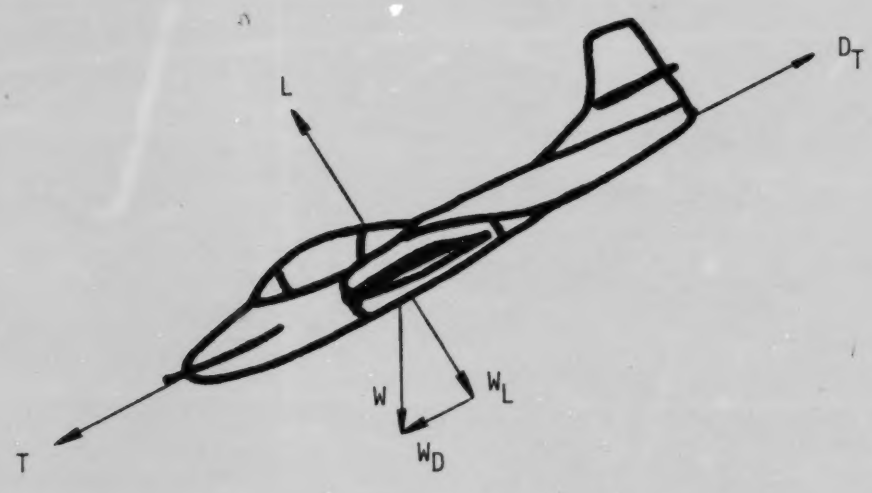


Figure 5. Level Descent

Idle power will be used for constant airspeed descents. In a descent, W_D acts with thrust. The pitch is adjusted enough to keep W_D equal to the amount thrust reduced so the airspeed will be constant. As in a climb, with the thrust a constant (idle), W_D is varied by pitch attitude to maintain a constant airspeed (see Figure 5).

F. Correction for Deviations: It is important that you learn to recognize deviations from desired flight attitude parameters and the inputs required to correct for deviation. In the first example (Figure 6) straight and level flight is the desired condition. The example shows an aircraft in a descent to the left. To correct back to level flight, the nose must be raised by pulling aft on the control yoke, and by turning the yoke to the right until the aircraft is returned to straight and level flight. The rest of the examples show an aircraft in some flight attitude other than the desired attitude of straight and level

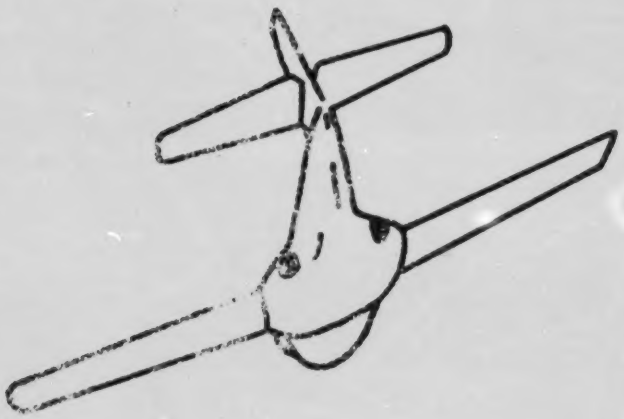
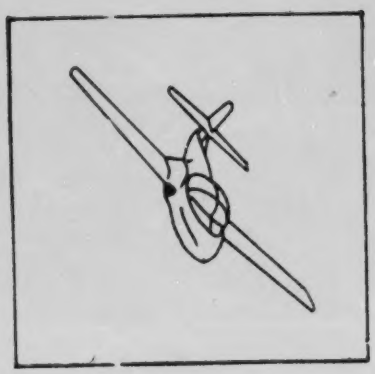
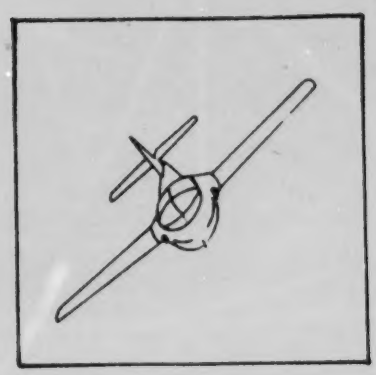


Figure 6. Straight and Level Flight Desired

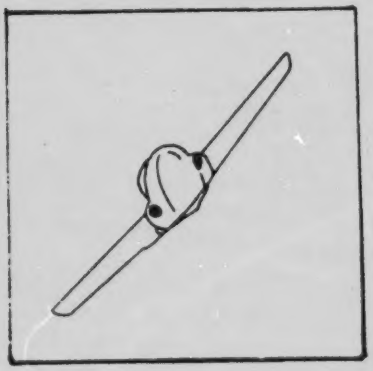
flight. At the bottom of each example are the basic inputs to correct for the flight attitude deviation.



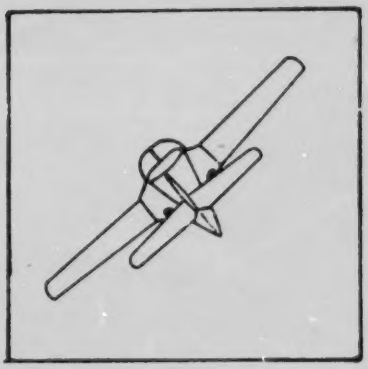
Control Yoke Right & Aft



Control Yoke Left & Aft



Control Yoke Forward & Left



Control Yoke Forward & Right

Figure 7. Incorrect Flight Attitudes

III. ATTITUDE INSTRUMENT FLYING: Flying an aircraft in a visual environment where reference to a natural horizon is available, the pilot obtains the majority of his information for aircraft control and flight attitude looking outside the windshield. However, in the absence of a visual horizon, such as flying in a cloud, the pilot must obtain this attitude information from the special instruments in the cockpit which artifically represent the outside world. From this requirement comes the concept of "ATTITUDE INSTRUMENT FLYING." Simply stated, this means that the attitude of the aircraft, i.e., its angle of bank or angle of pitch, is displayed on an attitude direction indicator (ADI), (Figure 8) or artificial

horizon located on the instrument panel directly in front of the pilot.

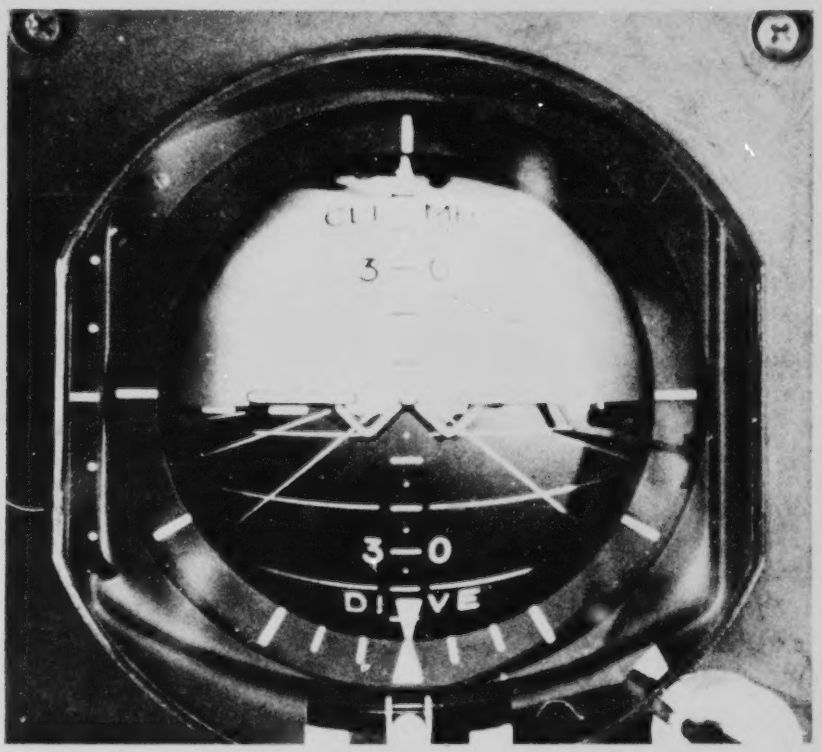


Figure 8. Attitude Direction Indicator

With this intricately calibrated instrument properly adjusted, the pilot can tell if he's climbing, descending, turning, or a combination. When the aircraft is straight and level, the ADI can be adjusted to superimpose the miniature aircraft symbol on the horizon line of the attitude sphere. In Figure 8, the miniature aircraft is above the dashed horizon line one bar width. This display can be adjusted to a level flight representation by turning the control knob in the lower right corner of the instrument. When subsequent changes in pitch are made (i.e., raising or lowering the nose), the angle of pitch can be measured by

referring to the calibrations on the sphere. The sphere is calibrated in degrees with increments every five degrees. The width of the miniature aircraft fuselage dot and wings is approximately 2-1/2°.

This instrument alone, however, does not tell the whole story. Along with it, like in a car, are other instruments which will accurately provide performance information.

First, we have a speedometer called an airspeed indicator (Figure 9). It displays airspeed in nautical miles per hour, or knots. Unlike

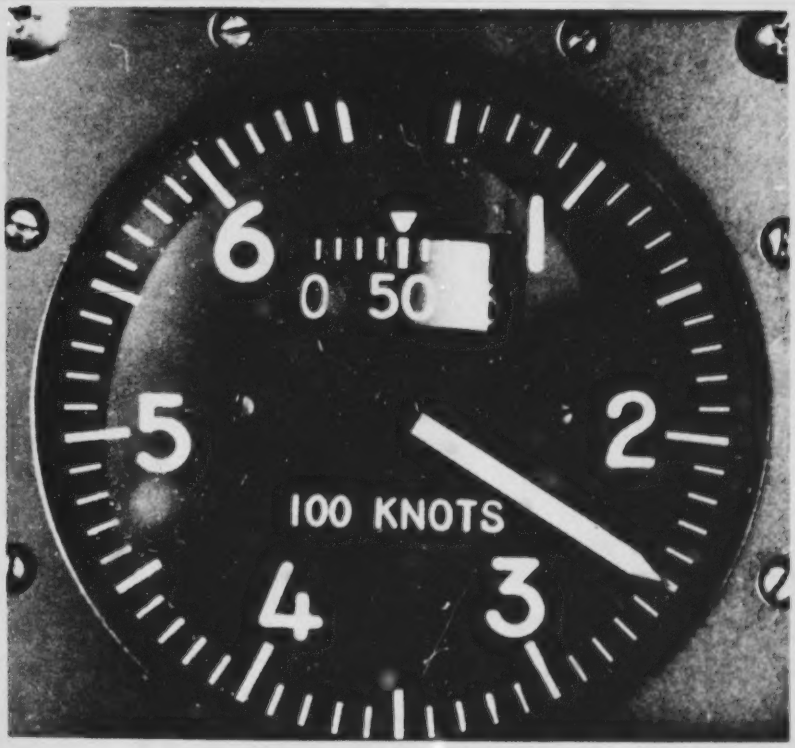


Figure 9. Airspeed Indicator

driving, an aircraft requires a certain minimum speed to stay airborne. In a car your concern for speed is the fine associated with excessive

speed. In an aircraft, your concern is keeping enough speed to maintain flight. The large pointer will indicate airspeed calibrated to 10 knots. The drum provides a more accurate reading to the nearest knot. Airspeed can be controlled with power or pitch or both.

Next is the altimeter (Figure 10). In a car, the terrain beneath

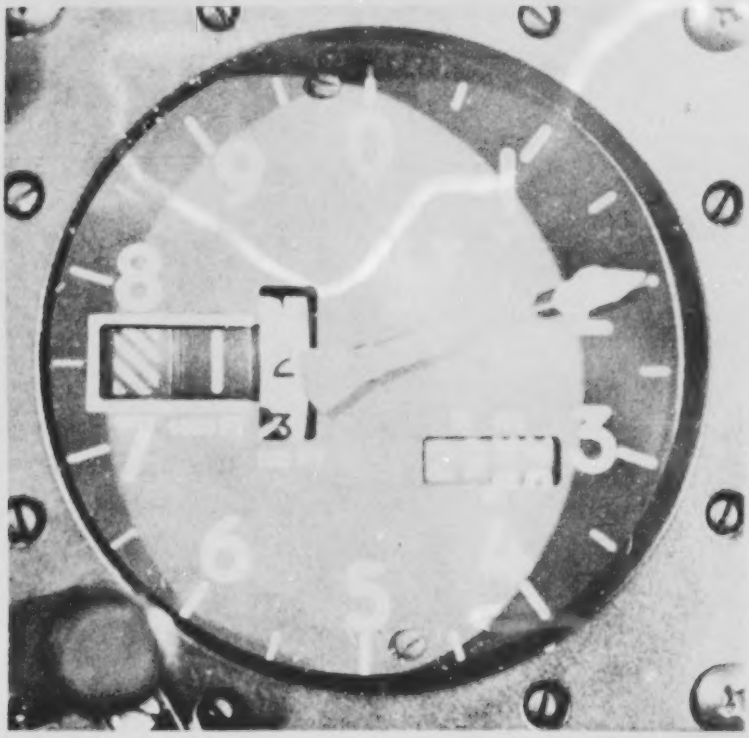


Figure 10. Altimeter

your wheels relieves you of that consideration. However, since an aircraft operates with the prime concern of staying off that terrain, an altimeter provides the information telling him how high the aircraft is. It is calibrated in 10s, 100s, 1000s and 10,000s of feet. The left digit drum has a 10,000' warning symbol (hash marks) which, when visible, tells the pilot he is below 10,000'.

Next is the vertical velocity indicator (Figure 11). When the aircraft is in a climb or descent, it is often important to know the rate.

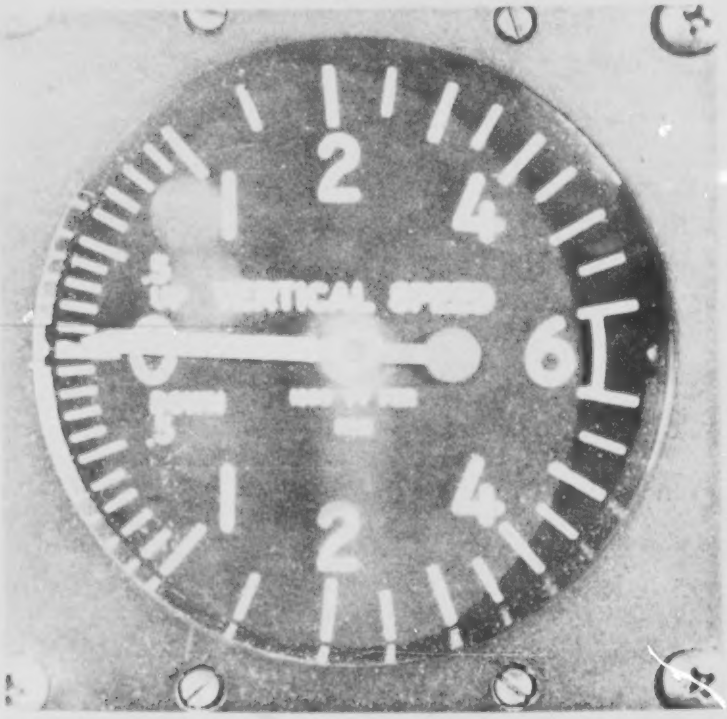


Figure 11. Vertical Velocity Indicator

Rate of climb or descent information is helpful to calculate the time required to change altitude a certain amount. The vertical velocity indicator (VVI) is an excellent instrument for quickly alerting the pilot to a deviation trend developing. It is calibrated in feet per minute. Climbs will be indicated when the needle is in the top portion of the case and vice versa for descents. The vertical velocity indicator is also used to calculate leadpoints for level offs.

The next instrument of primary importance is the heading indicator (Figure 12). Roads on the ground provide directional guidance for a car.

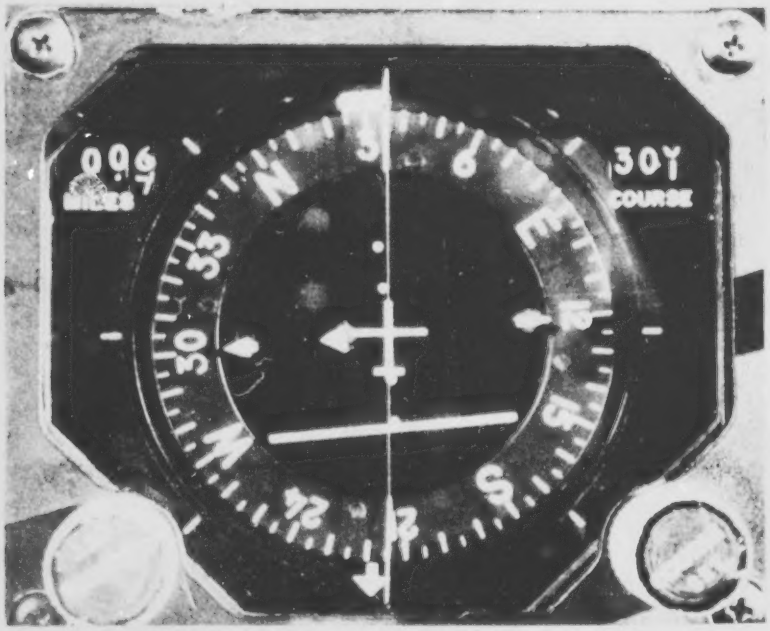


Figure 12. Heading Indicator

In the air however, we need a compass device to keep us on a "road." The heading indicator is calibrated in 5-degree increments on a compass card from North (360°) around either way to North again. For example, a heading of 180° is a heading due South. The heading is read under the hairline in the 12 o'clock position on the case. During a turn, the heading will be constantly changing. In straight and level an exact reading can be made.

Although all engine instruments are important in the operation of

an aircraft, the T-40 only requires you to be familiar with the tachometers (Figure 13). They are self-generating instruments which indicate

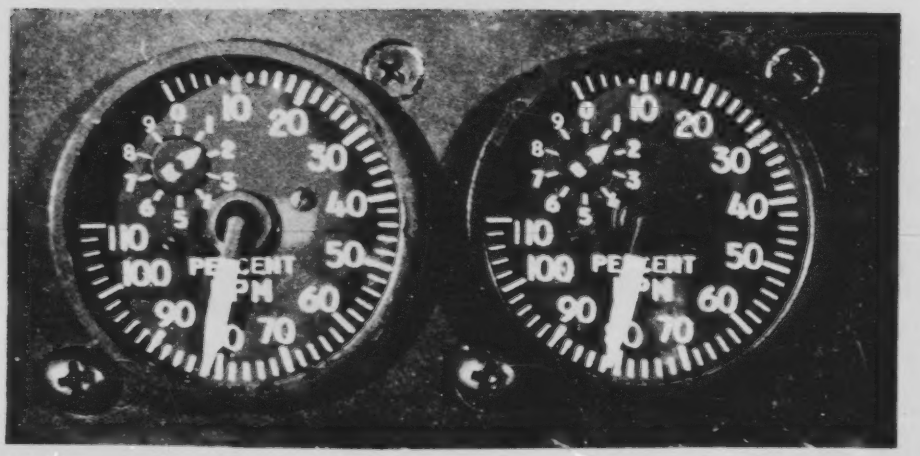


Figure 13. Tachometers

engine speed in percentage of rated RPM. The outer scale is calibrated in 2% increments. For readings as sensitive as 1/2%, the smaller pointer is used. You will use them as a means of selecting a desired engine power setting by moving the throttles located between the seats.

All of the instruments described thus far represent those which are most commonly used to keep you informed of aircraft control and performance. You may have noticed while driving a car that your eyes occasionally leave the road to check the speedometer or the gas gauge

or some other gauge. This is called a crosscheck and is of major importance while flying. Stated in other words, crosscheck is the division of your attention among the instruments in the cockpit to detect deviations and to maintain timely, orderly, and positive aircraft control. Figure 14 is a layout of the portion of the instrument panel you will be using.

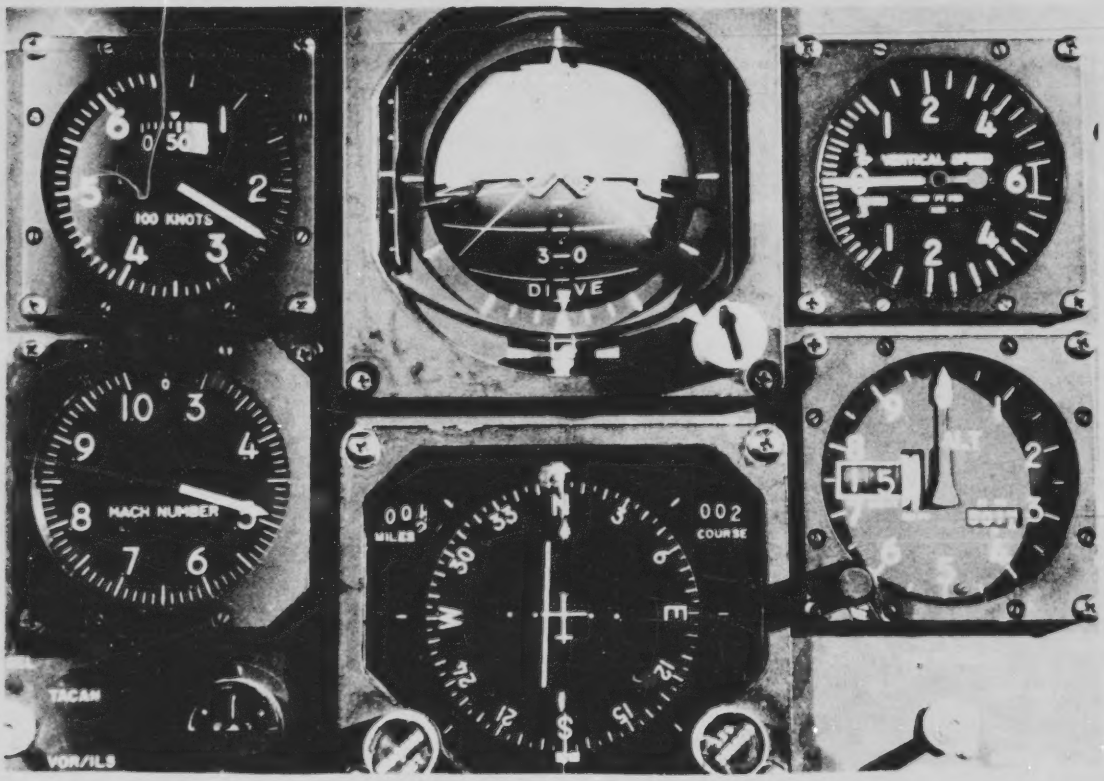


Figure 14. Left Instrument Panel - Straight and Level Flight

IV. MANEUVER DESCRIPTIONS:

Before we discuss each maneuver in detail, we will look at the concept of the crosscheck in more detail. There are two basic types: the centralized crosscheck where one or two instruments at the most require

almost full attention, and the rhythmic scan where your attention is divided among all the instruments with the attitude indicator at the center.

The centralized crosscheck is used when transitioning; i.e., entering a maneuver from a present steady state or exiting a maneuver to a steady state. The centralization on an instrument is necessary to establish new flight attitudes and power settings to control the aircraft. This central attention is most often on the attitude indicator.

The rhythmic scan is used when the aircraft is in a steady state; e.g., level turn, steady climb, etc. Here, the attitude indicator is monitored for attitude control information while the rest of your attention is divided among the performance instruments to detect deviations from desired parameters. If all the performance instruments are as desired, the crosscheck continues rhythmically. If there is a deviation, a correction is made on the attitude indicator. Then the scan resumes, paying particular attention to the instrument(s) with the deviation until the desired parameter is regained.

The exit transition differs from the entry in that, to reach the new desired parameters exactly, lead points will have to be determined at which the exit transition will begin. Various instruments, depending on the maneuver, will be used to determine these lead points.

A discussion of crosscheck is included in each maneuver description.

A. Straight and Level Flight (ST&L): Straight and level flight is a steady state condition where the four basic forces acting on the aircraft are balanced, i.e., lift = weight; thrust = drag, and airspeed,

altitude and heading are constant. Figure 14 is a depiction of the instruments as they should appear with the parameters established from the chart below.

ST&L

A/S	ALT	HDG	VV	PITCH	BANK	POWER (RPM)
250K	15M	360°	ZERO	LEVEL	LEVEL	81.5%
C	C	C	C	V	V	V

C stands for constant and not normally changeable.

V stands for variable meaning it may vary as a result or may be intentionally varied to obtain a result.

K stands for knots.

M stands for 1000'

Deviations from airspeed in straight and level are corrected with power; deviations from altitude are corrected with pitch. Normally, you will interpret the altitude deviation in feet, double the value, and use a vertical velocity rate equal to the new value. For example, if altitude is off by 300', a rate of 600 fpm would be used to correct back. This provides a very controllable return to desired. Deviations from heading are corrected with bank. Normally, an angle of bank equal to the number of degrees of heading is used to correct back to desired, but never more than 30° bank. For example, if the heading is 20° off desired, 20° of bank would be used when turning back to the desired heading. Deviations from more than one constant are corrected with a combination of pitch, bank, and power. Straight and level can be considered the basic maneuver

unit of flight. From ST&L, turns, climbs, descents, and combinations of these are initiated. Your first flight will begin from a frozen state of straight and level flight at the parameters listed above.

The crosscheck of instruments in ST&L is a rhythmic pattern scan originating from the attitude indicator (representing the hub of a wheel) to the various performance instruments (as though looking out a spoke to the rim then back to the hub). If deviations are found on the performance instruments, the attitude indicator is used to make measured corrections to regain desired readings.

B & C. Normal 30° Bank Turn to a Heading: (B - to the left; C - to the right). (See Figures 15 and 16.) These two maneuvers are identical except for direction of turn. A level turn is a steady state condition where lift, weight, thrust, and drag are balanced at a constant airspeed, altitude, and angle of bank.

LEVEL 30° BANK TURN

A/S	ALT	HDG	VV	PITCH	BANK	POWER (RPM)
250K	15M	-	ZERO	NOSE HI	30°	81%+
C	C	-	C	V	C	V

Deviations from airspeed in a level turn are corrected with power; deviations from altitude are corrected with pitch. In a steady state turn, heading is constantly changing. Notice that the turn parameters chart has no value for heading. Consideration for heading comes in prior to roll out on a specified heading. Notice also on the parameters chart that bank angle is a constant. In ST&L, bank is variable to keep

heading constant. In a steady state turn, heading is supposed to change, thus bank angle is held constant. Notice also (1) a slightly increased pitch attitude, and (2) a slightly increased power (RPM) requirement. Item 1 above means that when an aircraft is banked, lift is lost and will cause a descent. Pulling back on the yoke a slight amount will generate new lift equal to that lost from banking and keep lift = weight. Hence, the pitch will appear nose high. Item 2 is required because the generation of lift produces new drag and is counter-balanced with a slight power increase so thrust = drag.

A left turn and a right turn differ most noticeably in how they appear on the attitude indicator.

Normal turns to a heading have the requirement of completing the turn on a specific heading. A turn is entered with central attention on the ADI, by turning the yoke in the direction of desired turn to increase bank from zero to 30° left (or right). When the bank angle is established the yoke is returned to neutral. The pitch is increased slightly by pulling back on the yoke. When the aircraft is in a banked attitude, pitch information is represented by referencing the miniature aircraft fuselage dot to the center of the horizon line on the sphere. The airspeed will decrease slightly with this increase in pitch. So, the power is increased slightly and crosschecked to prevent this airspeed decrease. When the bank is established and the airspeed is stable, the turn is in a steady state. At this point the crosscheck reverts to a rhythmic scan of all the instruments to monitor performance and detect errors.

Before the desired heading approaches the top index of the heading

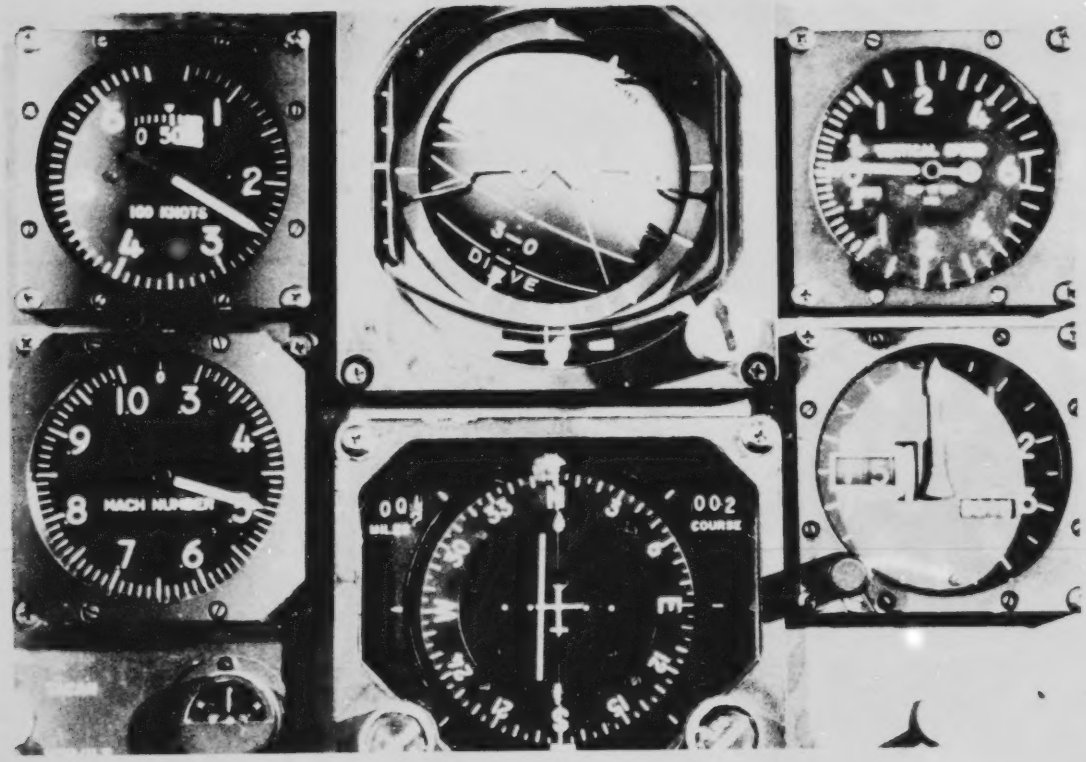


Figure 15. Normal 30° Bank Turn Left

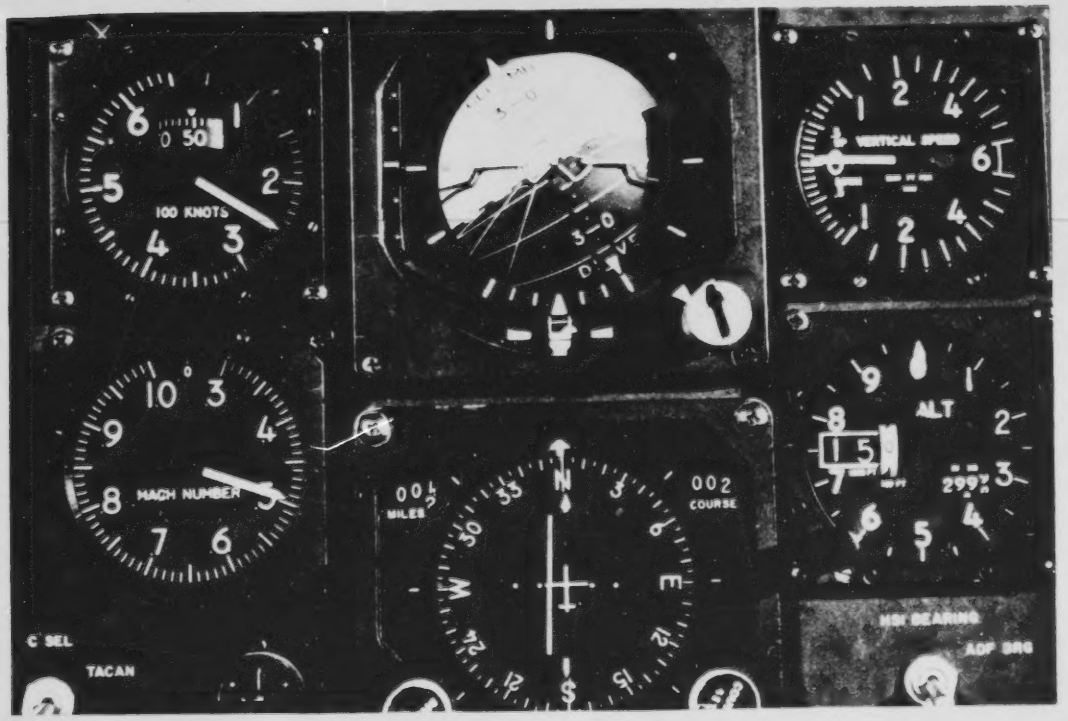


Figure 16. Normal 30° Bank Turn Right

indicator, the pilot must determine a lead point to begin a roll out. Ten degrees of lead is a technique. Ten degrees prior to the desired heading, centralize your attention on the attitude indicator and decrease the bank to zero. This will slowly complete the turn on the desired heading. When the wings are level, scan the instruments for desired parameters. The pitch will have to be lowered back to level and the power reduced to the straight and level setting. The most important aspect of rolling in or out of a turn is a consistent roll rate. Once you've developed a consistent roll rate, you can select your own lead point to roll out of a turn on a heading.

D. Constant Airspeed Climb: A steady state climb is a balanced condition of lift, weight, thrust, and drag where the flight path of the aircraft is upward. Airspeed and heading are constant. Altitude and vertical velocity are variable in the steady state part of the climb.

CONSTANT A/S CLIMB

A/S	ALT	HDG	VV	PITCH	BANK	POWER (RPM)
250K	-	360°	CLIMB	NOSE HI	LEVEL	92% FULL
C	-	C	V	V	V	C

Deviations from airspeed are corrected with pitch. Deviations from heading are corrected with bank. Climbs are always made to specific altitudes but for the discussion of the steady state portion of a climb, altitude is not considered. The basic differences in a climb display from a straight and level crosscheck are: (1) a nose high picture on the attitude indicator instead of level (about 4°), (2) a constantly

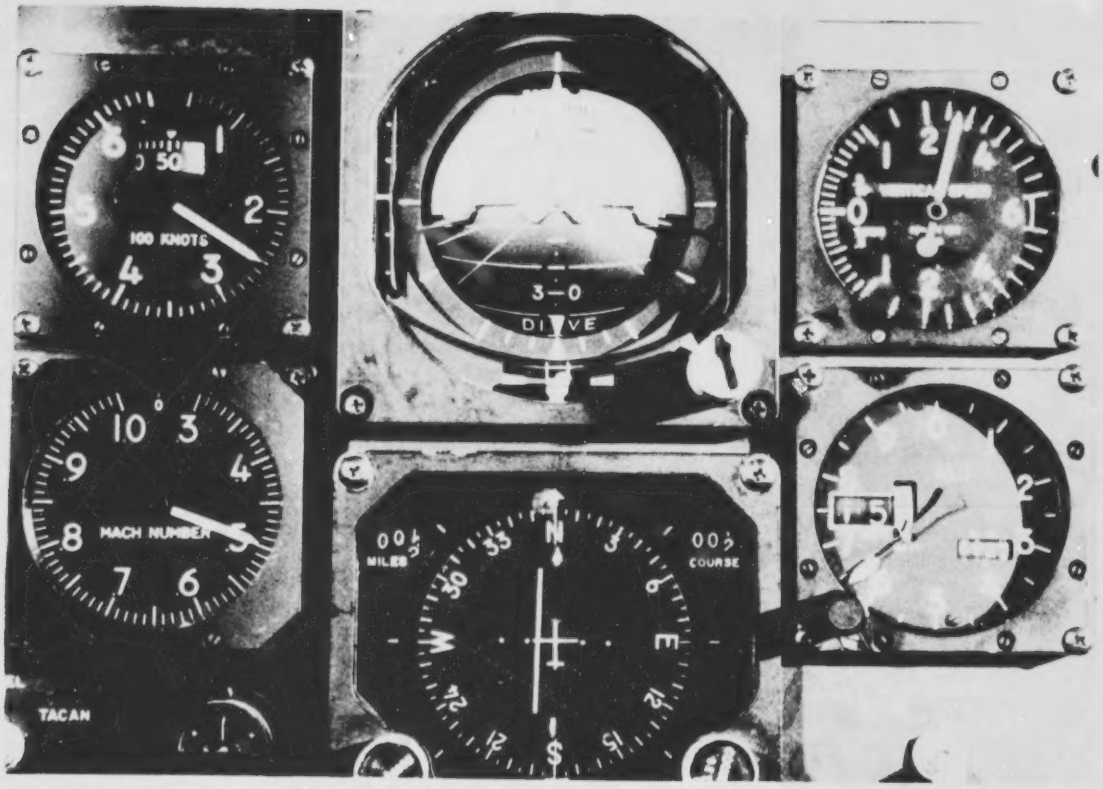


Figure 17. Constant Airspeed Climb

increasing altitude, (3) a climb indication in vertical velocity, and (4) power at 92% instead of the 81.5% recommended at 15,000' for 250K. (Figure 17.)

Since the power is a constant, the only variable for airspeed control is the pitch (i.e., inputs to the control yoke). In straight and level, airspeed is controlled with power as a variable. In a climb (or descent), airspeed is controlled with pitch.

You will be entering a climb from straight and level. Therefore, this portion of the discussion will cover the entry transition to a

climb. With the conditions for straight and level stabilized, look at the attitude indicator and slowly raise the nose to a predetermined approximate pitch while the power is simultaneously increased to full power, crosschecking the airspeed. The goal is full power, nose high, and no change in airspeed. This means the raising of the nose and the increase of power must be accomplished to meet these goals. The secret word is slowly. Once the power reaches full, airspeed is controlled solely with pitch. At this point you have established the steady state climb. Now the crosscheck goes into a scan as the steady climb progresses.

The last part of the climb maneuver is the exit transition, or leveloff. The two considerations here are (1) when to begin the leveloff to arrive exactly on the new selected altitude and (2) how to perform the level off.

1. In a steady state climb the vertical velocity is fairly constant at some rate. The level off is begun when the aircraft reaches an altitude below the desired equal 10% of the vertical velocity. For example, if the vertical velocity is fairly constant at 2000 fpm the level off should be started 200 feet prior to the desired level off altitude. As the altitude nears the lead point, begin to place more attention from your scan.

2. The level off is performed in a reverse manner from the entry to the climb. At the selected lead point, the nose is lowered to a level reference on the attitude indicator and the power is simultaneously reduced to the approximate recommended setting for the selected airspeed at the new altitude. When the level off is complete, the aircraft is

back in straight and level flight.

Some of your climbs will be performed without requiring you to determine when to level off. The IP will direct a level off at which time you will perform the mechanics of leveling off. Later on you will be expected to determine when to begin a level off as well as perform it.

E. Constant Airspeed Descent: A steady state descent is a balanced condition of lift, weight, thrust and drag where the flight path of the aircraft is downward. Airspeed and heading are held constant. Altitude and vertical velocity are variable in the steady state part of the descent.

CONSTANT A/S DESCENT

A/S	ALT	HDG	VV	PITCH	BANK	POWER (RPM)
250K	-	360°	DESCENT	NOSE LOW	LEVEL	IDLE
C	-	C	V	V	V	C

As in a climb, airspeed is controlled with pitch. The basic differences in a descent display from straight and level crosscheck are: (1) a nose low picture on the attitude indicator, (2) a constantly decreasing altitude, (3) a descent indication on the vertical velocity, and (4) power at idle RPM. See Figure 18.

A descent is entered much in the same manner as a climb except that power is reduced to idle and the nose is lowered to maintain airspeed. The level off considerations are the same as for a climb. Refer to the discussion of a climb.

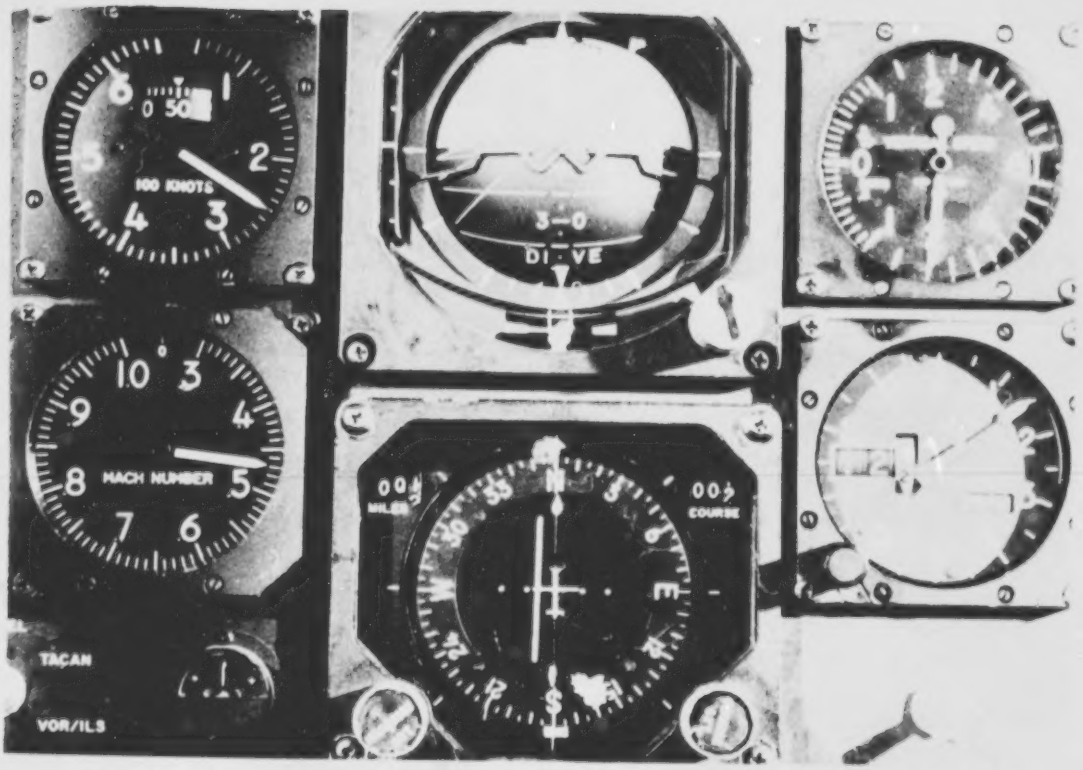


Figure 18. Constant Airspeed Descent

One final consideration is that of trim. An aircraft flying at a constant airspeed requires a specific pitch attitude to maintain a constant altitude. Since the elevator controls the pitch attitude, the yoke is moved forward or aft to keep the pitch attitude appropriate to maintain level flight. Once the position of the elevator to hold level flight is determined, the trim control is used to help hold the position. Trim is actuated by a thumb switch located on the left handle of the yoke. First position the yoke to hold the appropriate pitch attitude. Then monitor attitude indicator for pitch changes as you relax your grip

on the controls. If a change occurs, re-establish the desired pitch and actuate the trim button in the direction you move the controls, i.e., if the pitch lowers as you relax, pull back on the yoke until the pitch is correct and click the trim switch rearward. A similar trim activity is used for aileron trim.

It is important to learn to use trim for smooth and precise aircraft control. The trim button in the T-40 is typical of the kind on most fighter stick grips.

Pretraining Self-Test

This self-test contains question items to help you test your knowledge of the pretraining guide information. Examine each question and select the most correct answer. The answer is located beneath the hash marks directly below each question.

To use this self-test, cover the answer below the marks, read the question, and make your selection. Then, check the answer against yours. If you selected an incorrect answer, go back and read the applicable section of the pretraining guide.

1. What is the name of the concept used to describe flying by reference to instruments?

   a. Instrument aircraft control.

   b. Attitude instrument flying.

   c. Basic instrument flying.

   d. Pitch, bank, and power control.

////////////////

b.

2. What is considered the basic unit of flight?

   a. Pitch attitude.

   b. Constant airspeed.

   c. Bank attitude.

   d. Straight and level flight.

////////////////

d.

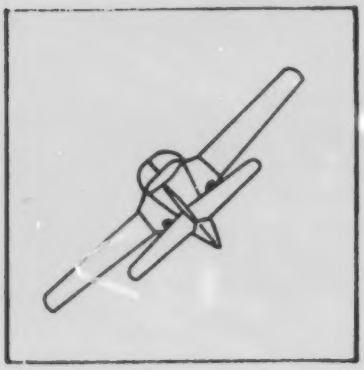
3. Match the instrument with the parameter it displays.

a. Attitude indicator	_____	RPM in %
b. Altimeter	_____	Speed in knots
c. Airspeed indicator	_____	Direction in degrees
d. Vertical velocity indicator	_____	Pitch and bank in degrees
e. Heading indicator	_____	Rate of climb/descent in fpm
f. Tachometer	_____	Altitude in feet

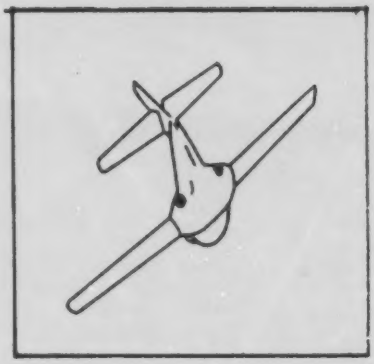
////////////////

f, c, e, a, d, b

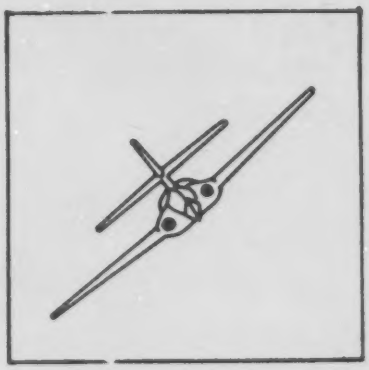
4. Select the answer which most correctly describes the aircraft attitude in each of the displays below.

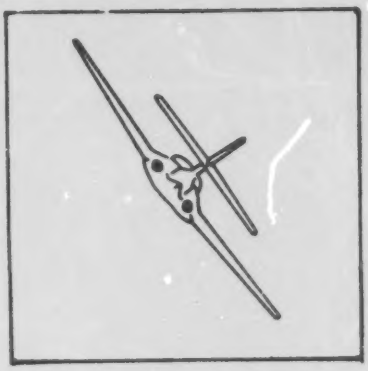


a. Straight and level
b. Left climbing turn
c. Right climbing turn
d. Level descent



a. Straight and level
b. Left climbing turn
c. Right descending turn
d. Left descending turn





a. Normal left turn

b. Left descending turn

c. Straight and level

d. Level climb

a. Normal left turn

b. Steep right turns

c. Level descent

d. Level climb

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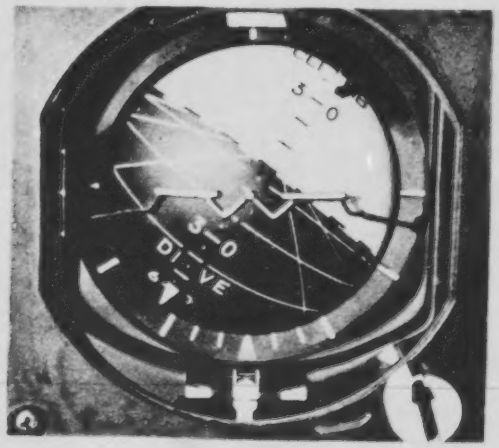
b, d, a, b

Questions 5-10. Select the correct instrument reading.

5.



a. 12° left bank, 5° nose low

b. 12° right bank, 5° nose low

c. 40° left bank, 10° nose low

d. 40° right bank, 10° nose low.

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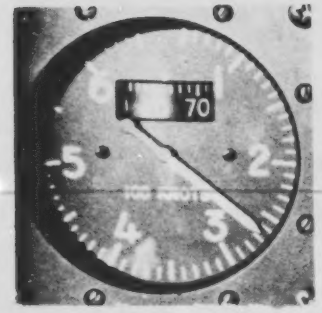
c.



a. 160 knots

b. 260 knots

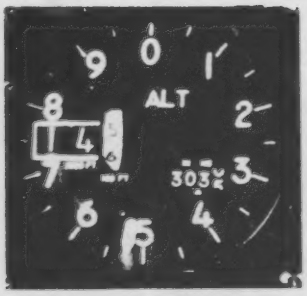
c. 162 knots

d. 262 knots

////////////////

d.

7.



a. 145.3'

b. 4530'

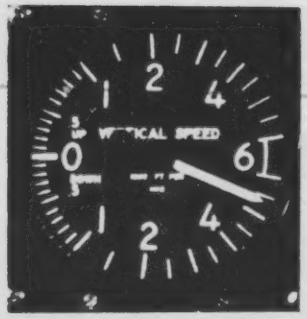
c. 14530'

d. 145,300'

////////////////

c.

8.



a. 540 fpm descent.

b. 540 fpm climb.

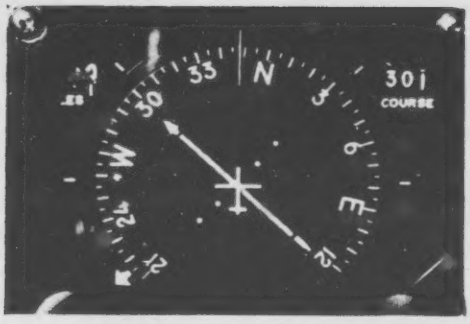
c. 5400 fpm descent.

d. 5400 fpm climb.

////////////////

c.

9.



73

a. 348°

b. 303°

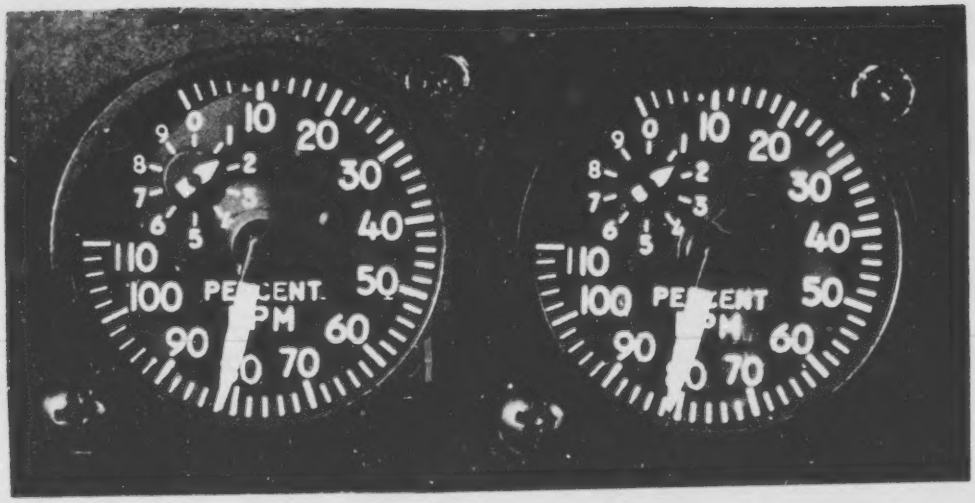
c. 033°

d. 338°

////////////////

a.

10.



a. 81%

b. 81.5%

c. 91.5%

d. 50%

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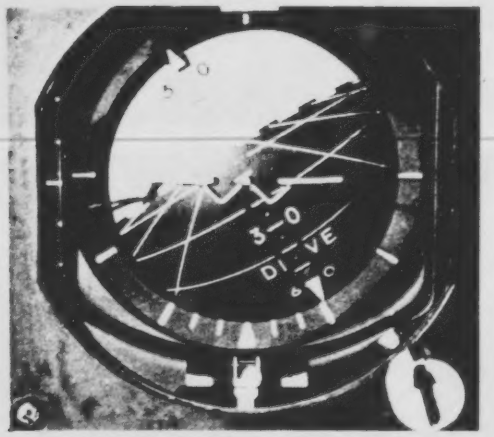
b.

74

Questions 11-13. Select the aircraft picture which most closely represents the attitude display.

11.



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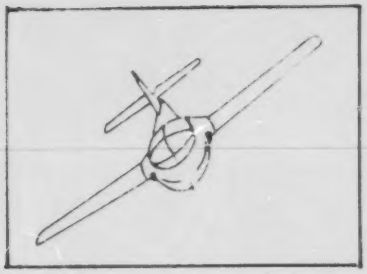
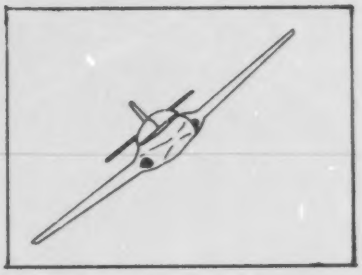
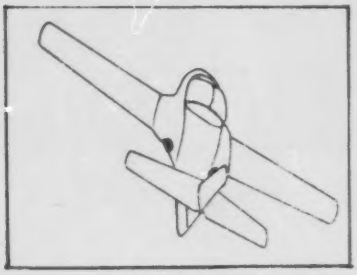


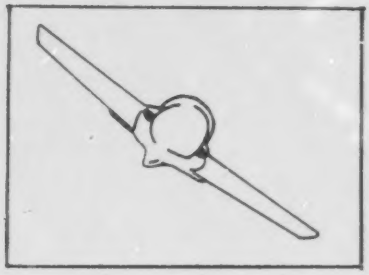
c.



b.



d.



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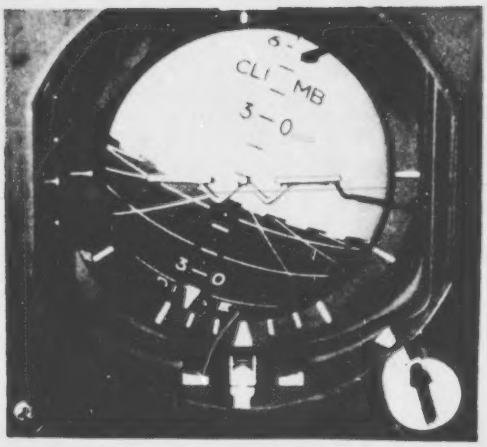
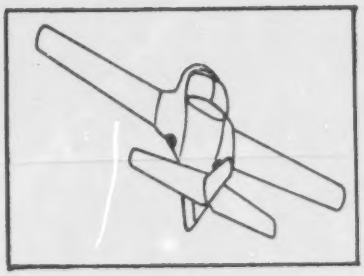
a.

12.



a.



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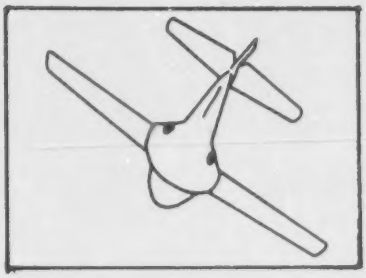

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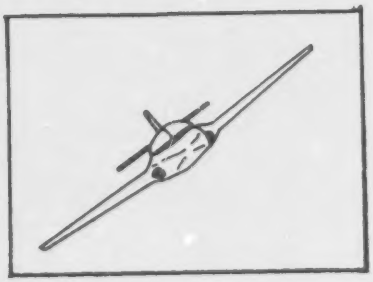

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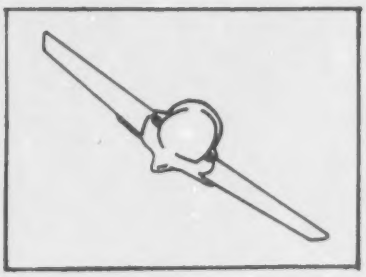

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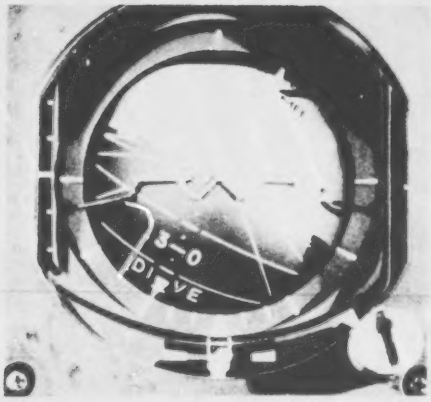
d.

13.



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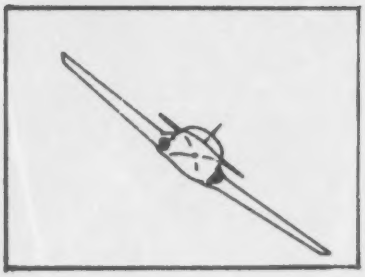
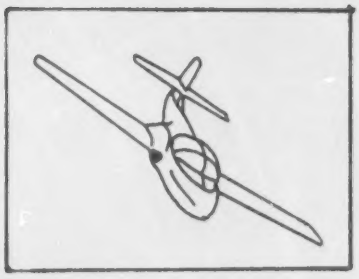
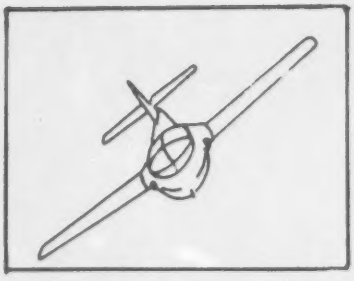


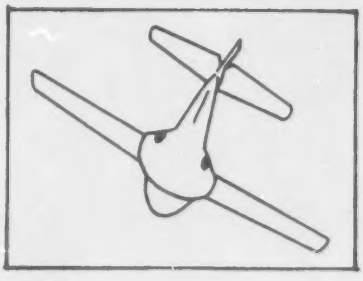
c.



b.



d.



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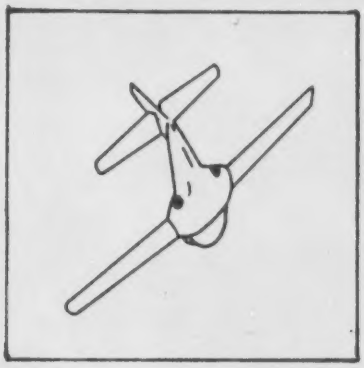
a.

14. Which answer most closely describes the display?



Airspeed: 255 knots

RPM: 53%

Vertical Velocity: 5400 fpm

a. Left climbing turn, constant airspeed.

b. Left descending turn, constant airspeed.

c. Level descent, constant airspeed.

d. Right descending turn, constant airspeed.

////////////////

b.

15. What are the control movements to return the aircraft to straight and level flight at a constant airspeed?

a. Stick left and aft, increase power.

b. Stick left and forward, decrease power.

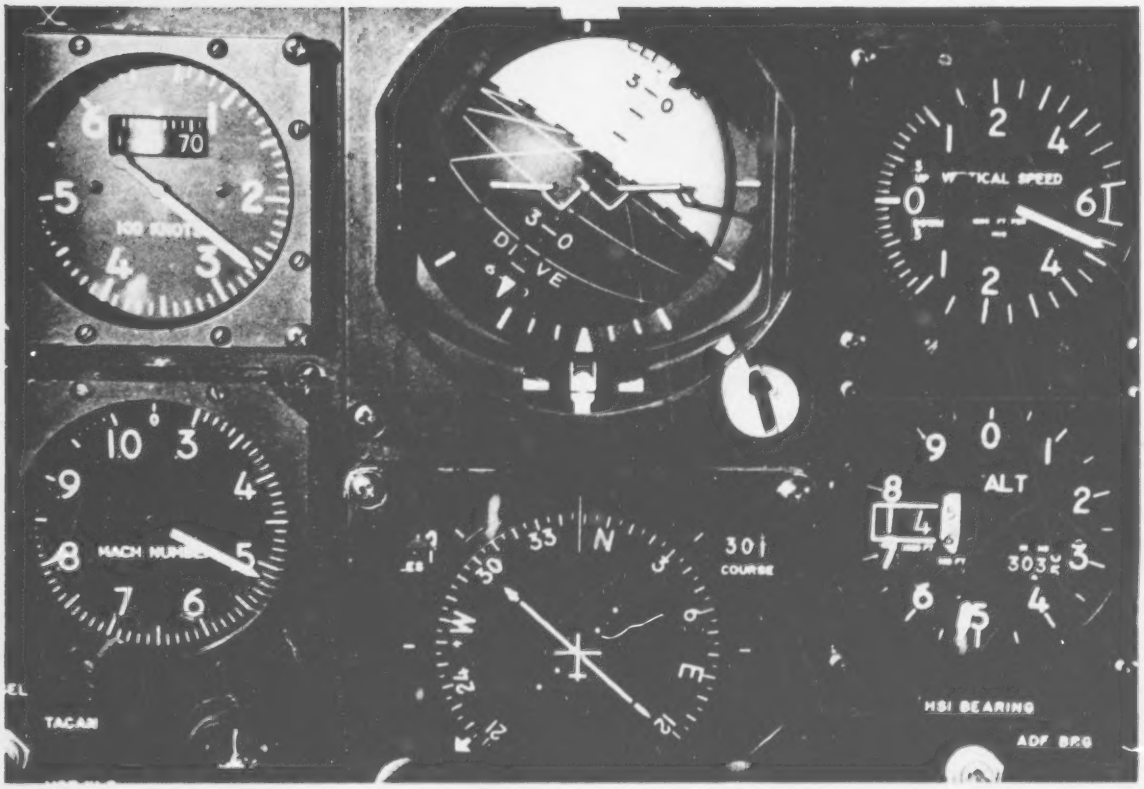
c. Stick right and aft, decrease power.

d. Stick right and aft, increase power.

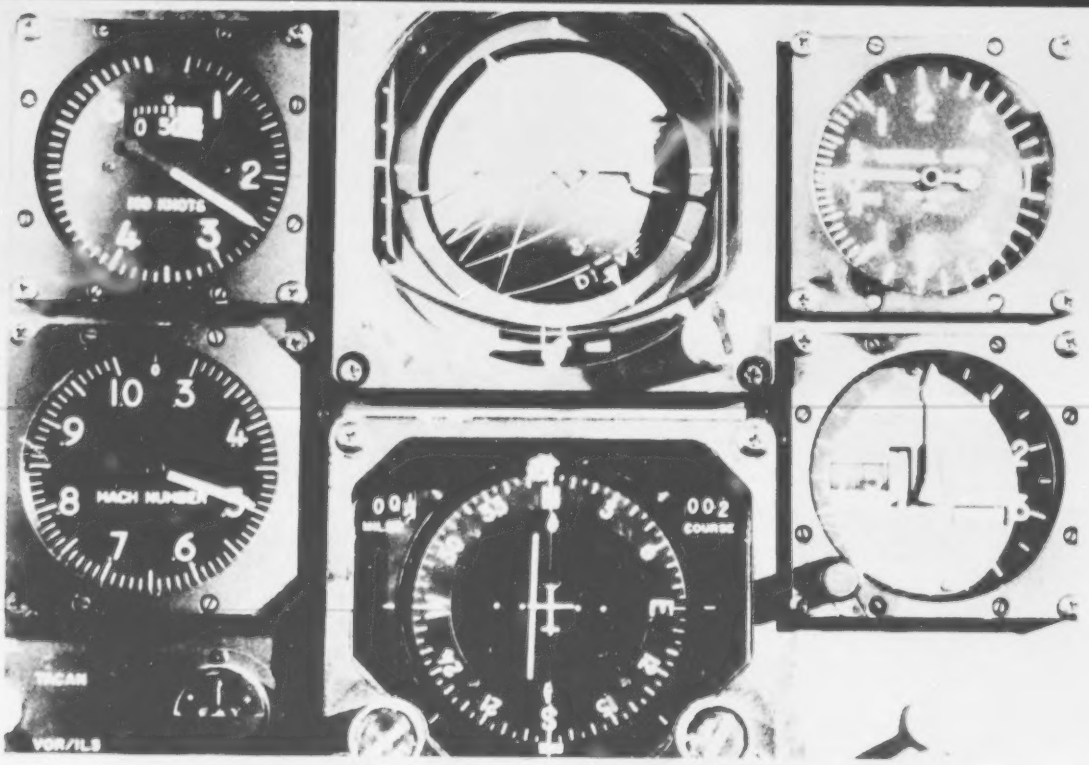
////////////////

d.

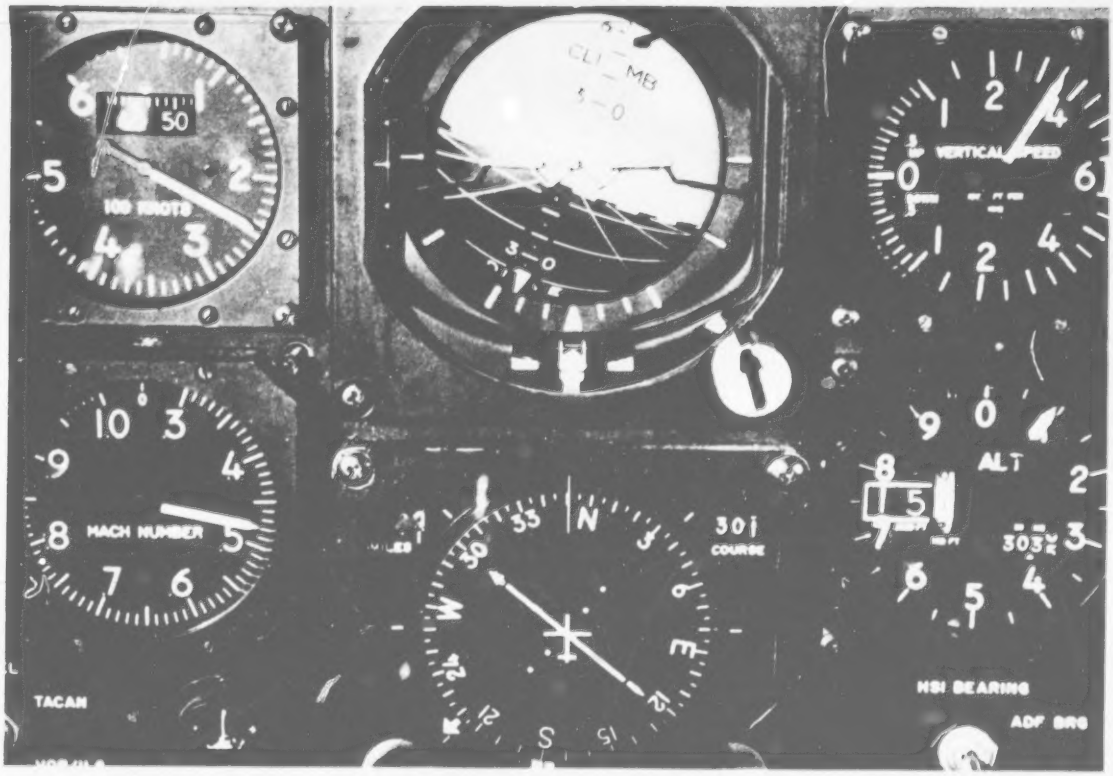
16. Which instruments most closely represent the aircraft in question 14?



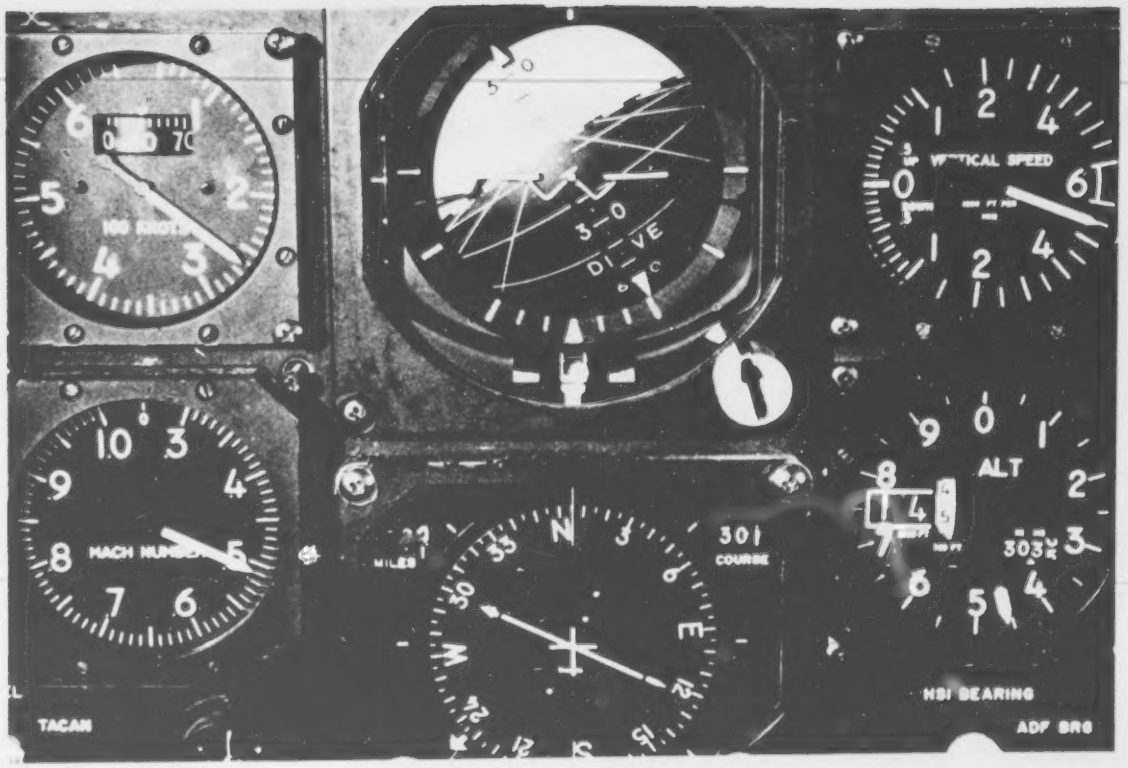
b.


100 KNOTS
MACH NUMBER
TACAN
VOR/ILS
002
COURSE

c.


50
100 KNOTS
MACH NUMBER
VERTICAL SPEED
ALT
5
303
301
COURSE
N
TACAN
HSI BEARING
ADF BRG

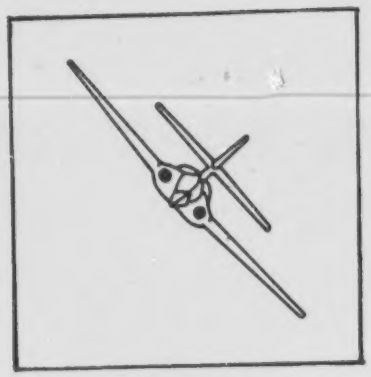
d.


3-0
DIVE
VERTICAL SPEED
ALT
MACH NUMBER
301
COURSE
MILES
TACAN
HSI BEARING
ADF BRG

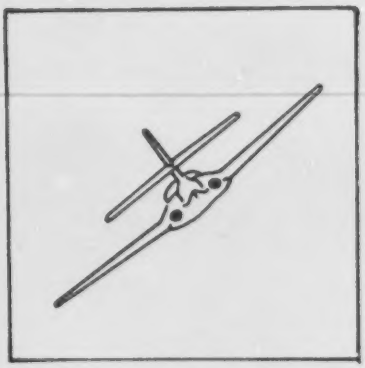
a

17. Which display accurately represents the new attitude from question 15?

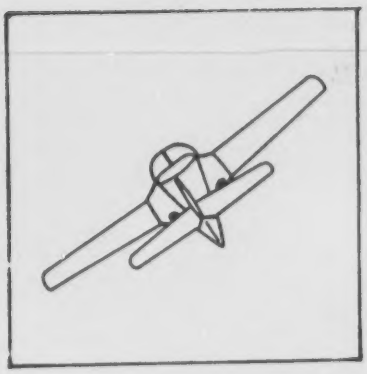
a.



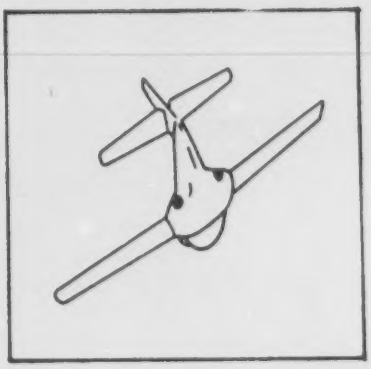
c.



b.



d.



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None

Questions 18-20. Select the answer which most closely describes the entry procedure (from straight and level flight) for:

18. Normal left turn.

a. Yoke left to 30° bank, increase pitch slightly, increase power slightly.

b. Yoke left to 30° bank, maintain pitch, increase power slightly.

c. Yoke left to 30° bank, maintain pitch, maintain power setting.

d. Yoke left to 30° bank, maintain pitch, decrease power slightly.

////////////////

a.

19. Constant airspeed climb.

a. Increase pitch to approximately 4°, increase power to maximum simultaneously.

b. Increase pitch to approximately 4°, increase power to maximum simultaneously at a rate which will maintain a constant airspeed.

c. Increase power to maximum, then increase pitch to approximately 4°.

d. Increase pitch to approximately 4°, then increase power to maximum.

////////////////

b.

20. Constant airspeed descent.

a. Decrease pitch to approximately 4°, decrease power to idle simultaneously.

b. Decrease power to idle, then decrease pitch to approximately 4°.

c. Decrease pitch to approximately 4°, then decrease power to idle.

d. Decrease pitch to approximately 4°, decrease power to idle simultaneously at a rate which will maintain a constant airspeed.

////////////////

d.

Glossary

LIFT - (L) The upward force in pounds generated by the movement of the wings of an aircraft through the air. Lift opposes weight. When the vertical component of lift (Lv) equals weight (W), the aircraft is in level flight. Lift can be controlled by the pilot.

WEIGHT - (W) The upward force on the aircraft in pounds acting downward perpendicular to the surface of the earth. Weight is not controllable by the pilot.

DRAG - (D_T) The force acting on the aircraft as it moves through the air opposing forward movement. Total drag (D_T) is the sum of parasite drag (Dp) and induced drag (Di). Dp is a result of the friction of a moving aircraft surface with the air. Di is the force generated by the production of lift. Drag is opposed by thrust. The pilot has limited control over drag.

THRUST - (T) The force generated by the engines propelling the aircraft forward. When thrust is applied to counterbalance drag, the airspeed will be stable. Thrust is controlled by the pilot by moving the throttles.

STRAIGHT AND LEVEL FLIGHT - The balanced condition of airborne flight where L = W and T = D_T. The aircraft neither climbs nor descends and maintains a constant airspeed.

PITCH - The angle between longitudinal axis and the horizon measured in degrees. It is controlled by the pilot and measured on the attitude indicator. Pitch is changed by moving the

controls forward or backward. A change in pitch moves the aircraft about the lateral axis of the aircraft.

BANK - The angle between lateral axis and the horizon is measured in degrees. It is controlled by the pilot and measured on the attitude indicator. Bank is changed by moving the controls to the left or right. A change in bank moves the aircraft about the longitudinal axis.

POWER - The force generated by the engines to produce thrust controlled by the pilot by moving the throttles to increase or decrease RPM. Generally used to control airspeed. Measured in percent RPM and observed on the tachometers.

LATERAL AXIS -

The axis from wing tip to wing tip around which the aircraft is pitched up or down by the elevator (yoke forward and aft).

LONGITUDINAL AXIS -

The axis from nose to tail around which the aircraft is banked by the ailerons (yoke left or right).

VERTICAL AXIS -

The axis perpendicular to the lateral/longitudinal axis around which the aircraft is yawed using the rudders.

APPENDIX E: PRETRAINING VIDEOTAPE SCRIPT

COLOR SLIDE: TITLE GRAPHIC AND MS T-40 TRAINER ZOOM OUT TO MS INCLUDE NARRATOR, WITH SCREEN IN BACKGROUND.	1. THE PURPOSE OF THIS BRIEFING IS TO RE-EXAMINE AND SUPPLEMENT THE INFORMATION PRESENTED TO YOU IN THE TAKE HOME PRETRAINING GUIDE YOU HAVE ALREADY COMPLETED. I WILL COVER BASIC PRINCIPLES OF FLIGHT AS THEY PERTAIN TO THIS PROGRAM, A DESCRIPTION OF THE FLIGHT INSTRUMENTS IN THE T-40, A DESCRIPTION OF EACH MANEUVER YOU WILL BE TAUGHT, AND A DISCUSSION OF TRIM AND CROSSCHECK.
MCU INSTRUCTOR	2. IMMEDIATELY FOLLOWING THIS BRIEFING, YOU WILL BE GIVEN A 30-QUESTION CRITERION MEASUREMENT ON THE PRETRAINING MATERIAL. OUR DISCUSSION OF BASIC PRINCIPLES OF FLIGHT WILL BE ORIENTED TO AN AIRCRAFT IN FLIGHT WITH NO CONSIDERATION FOR TAKEOFF AND LANDING. WE WILL ALSO BE COVERING A LIMITED RANGE OF FLIGHT MANEUVERING. THERE ARE FOUR BASIC FORCES ACTING ON AN AIRCRAFT IN FLIGHT:

COLOR SLIDE GRAPHIC
STRAIGHT & LEVEL
FLIGHT DIAGRAM
W/VECTORS

3. LIFT, WEIGHT, THRUST, AND DRAG. WHEN THESE FORCES ARE BALANCED AT A CONSTANT HEADING, ALTITUDE, AND AIRSPEED THE AIRCRAFT IS IN STRAIGHT AND LEVEL FLIGHT. WEIGHT ALWAYS ACTS PERPENDICULAR TO THE SURFACE OF THE EARTH AND LIFT ALWAYS ACTS PERPENDICULAR TO THE LONGITUDINAL AND LATERAL AXES OF THE AIRCRAFT. CONSIDER STRAIGHT AND LEVEL FLIGHT AS THE BASIC UNIT OF FLIGHT MANEUVERING FROM WHICH ALL MANEUVERS ARE BEGUN.

(SAME AS #3)

4. NOTICE FROM THE DIAGRAM THAT THE FORCE VECTORS SHOW A BALANCED CONDITION. THESE VECTORS ARE ASSUMING A CONSTANT AIRSPEED. IF AN AIRCRAFT WEIGHSS 6000 POUNDS, WE MUST GENERATE 6000 POUNDS OF LIFT TO MAINTAIN LEVEL FLIGHT. FOR SIMPLICITY WE WILL SAY THAT WITH A SET PITCH ATTITUDE AT A CONSTANT AIRSPEED WE WILL GENERATE THE LIFT REQUIRED TO OPPOSE WEIGHT. ALSO, WITH A CONSTANT AIRSPEED, THE THRUST AND DRAG VECTORS ARE BALANCED.

COLOR SLIDE
GRAPHIC
T-37 DIAGRAM
REAR VIEW
W/LIFT VECTORS

5. TOTAL DRAG IS COMPOSED OF PARASITE DRAG AND INDUCED DRAG. PARASITE DRAG IS THE FRICTIONAL FORCE OPPOSING MOVEMENT THROUGH THE AIR. FOR PURPOSES OF THIS STUDY, PARASITE DRAG WILL BE CONSTANT. INDUCED DRAG IS THE DRAG PRODUCED AS A BY PRODUCT OF LIFT PRODUCTION AND VARIES DIRECTLY WITH LIFT. LOOKING FROM THE REAR OF AN AIRCRAFT WE CAN SEE THE FORCES ACTING ON IT TO MAKE A TURN.

GRAPHIC SLIDE
LIFT VECTOR VISUAL
(CONTINUED)

6. BANK IS ESTABLISHED BY TURNING THE YOKE AND ROLLING THE AIRCRAFT AROUND THE LONGITUDINAL AXIS. SINCE LIFT ALWAYS ACTS PERPENDICULAR TO THE LATERAL AXIS, WHEN BANK IS ESTABLISHED THE LIFT VECTOR MOVES AND NO LONGER DIRECTLY OPPOSES WEIGHT. THIS IS WHEN WE BREAK DOWN THE LIFT VECTOR INTO ITS COMPONENTS, THE VERTICAL AND HORIZONTAL COMPONENTS.

GRAPHIC SLIDE - AIRCRAFT IN BANK REAR VIEW

7. THE VERTICAL COMPONENT WILL ALWAYS OPPOSE WEIGHT BUT IS DEPENDENT ON TOTAL LIFT. WITH A 6000 POUND AIRCRAFT AND NO CHANGE IN TOTAL LIFT, THE VERTICAL COMPONENT WILL BE SOMETHING LESS THAN 6000 POUNDS. THIS DEFICIENCY WILL CAUSE THE AIRCRAFT TO DESCEND. HOWEVER, THE VERTICAL COMPONENT OF LIFT CAN BE INCREASED PROPORTIONATELY BY PULLING BACK SLIGHTLY ON THE YOKE INCREASING THE PITCH SLIGHTLY.

GRAPHIC SLIDE - AIRCRAFT BANK (CONTINUED)

8. THIS BACK PRESSURE INCREASES THE TOTAL LIFT VECTOR AND WILL BALANCE THE LIFT/WEIGHT FORCES. THIS TOTAL LIFT INCREASE WILL PROPORTIONATELY INCREASE INDUCED DRAG, HENCE TOTAL DRAG AND TEND TO SLOW THE AIRSPEED. WE BALANCE THE THRUST/DRAG FORCES BY ADDING A SMALL AMOUNT OF POWER.

GRAPHIC SLIDE
REAR VIEW
(CONTINUED)

9. ONCE THE BANK IS ESTABLISHED AND THE PITCH AND POWER ARE INCREASED SLIGHTLY, THE AIRCRAFT FORCES ARE ONCE AGAIN BALANCED AND A LEVEL TURN AT A CONSTANT AIRSPEED CAN BE PERFORMED. THE FORCE WHICH TURNS THE AIRCRAFT IS THE HORIZONTAL COMPONENT. IF TOO MUCH OR NOT ENOUGH BACK PRESSURE IS APPLIED, THE AIRCRAFT WILL CLIMB OR DESCEND.

GRAPHIC SLIDE
REAR VIEW
(CONTINUED)

10. SIMILARLY, IF TOO MUCH OR NOT ENOUGH POWER IS ADDED, THE AIRSPEED WILL END UP TOO FAST OR TOO SLOW. THE AMOUNTS OF BOTH ARE APPLIED AS NECESSARY, HOWEVER, THERE ARE APPROXIMATE MEASURES WHICH WORK WELL TO STAY UP WITH THE AIRCRAFT. IN A TURN, THE APPROXIMATE PITCH INCREASE NEEDED IS ONE HALF A BAR WIDTH. THE APPROXIMATE POWER ADDITION IS ONE AND ONE HALF PERCENT.

GRAPHIC SLIDE - PROFILE GRAPHIC AIRCRAFT IN CLIMB.

11. HERE IS A DIAGRAM OF AN AIRCRAFT IN A SHALLOW CLIMB. IN A STABLE CLIMB THE WEIGHT COMPONENT BREAKS DOWN TO THE VECTOR OPPOSING LIFT AND THE COMPONENT SUPPLEMENTING DRAG. THE EXTRA DRAG IS COUNTERBALANCED BY INCREASING POWER, I.E., THRUST. THIS WILL MAINTAIN A CONSTANT AIRSPEED. A DESCENT IS SIMILAR EXCEPT THAT HORIZONTAL WEIGHT COMPONENT OPPOSES DRAG. THEREFORE, POWER IS REDUCED TO MAINTAIN BALANCE.

SLIDE-T-40 INSTRUMENT PANELS.

12. NOW LET US LOOK AT EACH INSTRUMENT YOU WILL BE USING TO FLY THE T-40. YOU WILL BE FLYING FROM THE LEFT SEAT. HERE IS A PICTURE OF THE INSTRUMENTS ON THE LEFT INSTRUMENT PANEL. THE ATTITUDE INDICATOR, THE AIRSPEED INDICATOR, THE VERTICAL VELOCITY INDICATOR, THE ALTIMETER, AND THE HEADING INDICATOR. THE TACHOMETERS ARE TO THE RIGHT OF THIS PANEL.

SLIDE-ATTITUDE DIRECTOR INDICATOR (ADI).

13. THE CENTER OF YOUR ATTENTION WILL MOST OFTEN BE THE ATTITUDE INDICATOR. WHEN PROPERLY ADJUSTED, IT WILL TELL THE PILOT IF HIS AIRCRAFT IS CLIMBING, DESCENDING, TURNING, OR A COMBINATION. THE GRAY PORTION OF THE SPHERE REPRESENTS THE SKY, THE BLACK IF THE GROUND. THE DASHED LINE BETWEEN IS THE HORIZON LINE. THE SPHERE IS CALIBRATED IN 5 DEGREE INCREMENTS AND MARKED AT 30 DEGREES WITH NUMBERS.

SLIDE - ADI (CONTINUED)

14. THE MINIATURE AIRCRAFT BAR IS SUPERIMPOSED ON THE HORIZON LINE IN LEVEL FLIGHT BY TURNING THE PITCH TRIM KNOB. THE THICKNESS OF THIS BAR IS ONE BAR WIDTH AND EQUALS 2½ DEGREES OF PITCH. THIS PICTURE HAS BEEN ADJUSTED TO ONE BARWIDTH NOSE HIGH FOR ILLUSTRATION. THE BANK POINTER IS ON THE BOTTOM WHERE THE BANK SCALE IS MARKED. EACH WIDE LINE REPRESENTS 30 DEGREES. THE FIRST 30 DEGREES IS FURTHER CALIBRATED IN 10 DEGREE INCREMENTS.

SLIDE - AIRSPEED INDICATOR.

15. THE SKY POINTER AT THE TOP HAS ONLY A ZERO BANK MARK. THE BANK POINTER ON THE BOTTOM WILL MOVE IN THE DIRECTION OF YOKE APPLICATION, I.E., IF THE YOKE IS MOVED LEFT, POINTER MOVES LEFT. THIS IS THE AIRSPEED INDICATOR. IT IS CALIBRATED IN TEN KNOT INCREMENTS ON THE OUTER SCALE WITH NUMBERS AT EACH 100 KNOT POINT. THE DRUM FURTHER DISPLAYS AIRSPEED IN TWO KNOT INCREMENTS. THIS DISPLAY SHOWS 250 KNOTS. THE AIRSPEED INDICATOR IS A PERFORMANCE INSTRUMENT.

SLIDE - ALTIMETER

16. THIS IS THE ALTIMETER. IT MEASURES ALTITUDE IN FEET MEAN SEA LEVEL. THE NEEDLE POINTS TO 100s OF FEET WITH A SCALE MARK EVERY 50 FEET. THE RIGHT DRUM ALSO DISPLAYS 100s OF FEET. THE NEXT DRUM DISPLAYS 1000s OF FEET. THE LEFT MOST DRUM DISPLAYS 10,000s OF FEET AND IS COVERED BY HASH MARKS BELOW 10,000 FEET MSL. THIS ALTIMETER SHOWS 1200 FEET MSL. THE ALTIMETER IS A PERFORMANCE INSTRUMENT.

SLIDE - VERTICAL VELOCITY INDICATOR.

17. THIS IS THE VERTICAL VELOCITY INDICATOR. IT MEASURES RATE OF CLIMB OR DESCENT IN FEET PER MINUTE. IT IS NUMBERED AT 1000s OF FPM CALIBRATED TO 100 FPM IN THE FIRST 1000 FEET. IT IS AN EXCELLENT INSTRUMENT TO INDICATE A TREND DEVELOPING, BUT DUE TO DESIGN, IT IS VERY SLOW TO SETTLE ON AN EXACT READING. THE VVI IS A PERFORMANCE INSTRUMENT. THIS VVI SHOWS ZERO FPM OR LEVEL FLIGHT.

SLIDE - HEADING INDICATOR.

18. THIS IS THE HEADING INDICATOR. THE ONLY FEATURES OF THIS INSTRUMENT WE WILL USE FOR THIS TRAINING ARE THE TOP INDEX OR UPPER LUBBER LINE AND THE COMPASS CARD. THE CARD IS CALIBRATED IN FIVE DEGREE INCREMENTS WITH NUMBERED DIGITS EACH 30 DEGREES. THE FOUR CARDINAL COMPASS POINTS ARE MARKED N, E, S, W, TO DETERMINE THE SHORTEST DIRECTION FOR A TURN TO A HEADING.

19. YOU SIMPLY LOCATE THE DESIRED HEADING ON THE CARD AND TURN THE YOKE IN THAT DIRECTION, I.E., HEADING LEFT SIDE, ROLL LEFT. THE DEGREE CALIBRATIONS GO FROM 001 AROUND TO THE RIGHT TO 360 DEGREES OR NORTH. THIS HEADING INDICATOR SHOWS 035 DEGREES.

SLIDE - TACHOMETERS.

20. THE LAST SET OF INSTRUMENTS USED ARE THE TACHOMETERS WHICH MEASURE ENGINE SPEED IN PERCENT RPM. THESE ARE CONTROL INSTRUMENTS. YOU WILL OPERATE BOTH THROTTLES TOGETHER SO BOTH TACS SHOULD ALWAYS HAVE THE SAME READING. THE LARGE NEEDLE IS CALIBRATED TO 2% INCREMENTS ON THE OUTER SCALE. THE INNER SCALE CAN BE READ TO ½%. THESE TACHOMETERS SHOW 81.5% RPM, THE SETTING YOU WILL USE FOR 250K AT 15,000 FEET IN STRAIGHT AND LEVEL FLIGHT.

SLIDE - INSTRUMENT PANEL.

21. THE MAX RPM IN THE T-40 IS 92% AND IS ACHIEVED BY MOVING THE THROTTLES FULL FORWARD. CROSSCHECK IS THE DIVISION OF YOUR ATTENTION AMONG THE INSTRUMENTS. CROSSCHECK CENTERS ON THE ATTITUDE INDICATOR AS THE PRIMARY CONTROL INSTRUMENT. FROM THIS INSTRUMENT, YOUR CROSS-CHECK SYSTEMATICALLY READS AND INTERPRETS THE PERFORMANCE INSTRUMENTS.

SLIDE - INSTRUMENT PANEL (CONTINUED).

22. WHEN A DEVIATION IS DETECTED ON A PERFORMANCE INSTRUMENT, YOUR ATTENTION RETURNS TO THE ATTITUDE INDICATOR WHERE MOST CORRECTIONS ARE INITIATED. THE INSTRUMENT SHOWING A DEVIATION IS SUBSEQUENTLY CHECKED TO SEE IF THE DESIRED READING HAS BEEN REGAINED OR IS SATISFACTORILY WORKING BACK TO DESIRED.

SLIDE - INSTRUMENT PANEL.

POINTER SHOWING CROSS-CHECK SCAN PATTERN.

23. WHEN ALL THE INSTRUMENTS ARE ON THE DESIRED PARAMETERS, THE CROSSCHECK IS A RHYTHMIC SCAN STEMMING FROM THE ATTITUDE INDICATOR GLANCING BRIEFLY AT EACH PERFORMANCE INSTRUMENT. YOUR ATTENTION WILL CENTRALIZE WHEN CORRECTING FOR A DEVIATION. YOUR CROSSCHECK WILL ALSO CENTRALIZE WHEN ENTERING OR EXITING A MANEUVER.

POINTER SHOWING CROSSCHECK.

24. ONCE ESTABLISHED IN A MANEUVER, A STEADY STATE CONDITION EXISTS. IN A STEADY STATE, THE CROSSCHECK IS RHYTHMIC SEARCHING FOR DEVIATIONS. HERE IS AN EXAMPLE OF A STEADY STATE RHYTHMIC CROSSCHECK. NOW LET US DISCUSS AN EXAMPLE OF A CORRECTION. SUPPOSE THE AIRCRAFT IS ALLOWED TO CLIMB SLIGHTLY IN STRAIGHT AND LEVEL. THE ALTITUDE WILL READ HIGH AND THE AIRSPEED WILL READ LOW.

25. SIMPLY LOWERING THE NOSE ON THE ATTITUDE INDICATOR WILL CAUSE A DESCENT RETURNING THE AIRCRAFT TO THE DESIRED ALTITUDE AND REGAINING THE DESIRED AIRSPEED. IF THE AIRCRAFT IS HIGH ON ALTITUDE AND HIGH ON AIRSPEED, LOWERING THE NOSE WILL REGAIN THE ALTITUDE BUT IT WILL INCREASE THE AIRSPEED EVEN FARTHER FROM DESIRED. THIS CORRECTION WOULD REQUIRE A POWER REDUCTION IN CONJUNCTION WITH A PITCH REDUCTION.

SLIDE - WIDE ANGLE INST PANEL

26. TRIM IS APPLIED TO ASSIST THE PILOT IN MAINTAINING SMOOTH CONTROL OF THE AIRCRAFT. WHEN PROPERLY ADJUSTED, THE TRIM WILL HELP MAINTAIN A STEADY STATE CONDITION. IF TRIM IS NOT ADJUSTED, THE AIRCRAFT WILL TEND TO DEVIATE THROUGH UNDESIRED CONTROL PRESSURES AND REQUIRE MORE ATTENTION BY THE PILOT. THE TRIM SWITCH IS LOCATED ON TOP OF THE LEFT YOKE HANDLE AND IS ACTIVATED IN CLICKS WITH THE THUMB.

POINTER TO TRIM SWITCH CONTROL.

27. WHEN UNDESIRED CONTROL PRESSURES ARE FELT, THE TRIM SWITCH IS ACTUATED AGAINST THE PRESSURE UNTIL THE PRESSURE IS RELIEVED. FOR EXAMPLE, IF YOU FEEL LIKE THE NOSE WANTS TO CONTINUALLY CLIMB FORCING YOU TO PUSH FORWARD ON THE YOKE FREQUENTLY, FIRST ESTABLISH THE YOKE POSITION BY ESTABLISHING THE DESIRED ATTITUDE DISPLAY, THEN ACTUATE THE TRIM SWITCH AGAINST THE PRESSURE.

MS - NARRATOR AND REAR SCREEN OF T-40 INSTRUMENT PANEL.

28. IN THIS CASE, FORWARD. BE SURE TO ACTUATE THE TRIM SWITCH IN SHORT CLICKS. THE SWITCH IS SPRING LOADED TO THE CENTER OR NEUTRAL POSITION.

NOW, LET'S TAKE A LOOK AT A FILM ILLUSTRATING THE MANEUVERS YOU'LL BE FLYING IN THE T-40. WE'LL BEGIN WITH STRAIGHT AND LEVEL, PROGRESS THROUGH A NORMAL TURN TO THE LEFT, NORMAL TURN TO THE RIGHT, A CONSTANT AIRSPEED CLIMB, AND A CONSTANT AIRSPEED DESCENT.

ZOOM IN TO FULL SHORT OF SCREEN. START MO PIX OF INSTRUMENT DEMO OF STRAIGHT AND LEVEL.

HERE WE SEE AN AIRCRAFT IN STRAIGHT AND LEVEL FLIGHT. AIRSPEED - 250 KNOTS, VVI - ZERO, ALTITUDE 15,000 FT., HEADING - 360, TACHOMETERS 81.5%.

POINTER SHOWS CROSS-CHECK SCAN ON SCREEN.

AT THIS POINT THE CROSSCHECK IS A RHYTHMIC SCAN SEARCHING FOR DEVIATIONS: ALTITUDE, AIR-SPEED, ATTITUDE, VERTICAL VELOCITY, ATTITUDE, ETC.

FILM CLIP LEFT TURN SEQUENCE.

THE NEXT MANEUVER WILL BE A 30 DEGREE BANK TURN TO THE LEFT TO A HEADING OF 270.

THE ATTENTION IS NOW CENTERED ON THE ATTITUDE INDICATOR AS THE BANK IS ESTABLISHED AT 30 DEGREES TO THE LEFT. SHORTLY AFTER THE BANK IS ESTABLISHED, THE POWER IS INCREASED TO 83%, THE APPROXIMATE POWER SETTING TO HOLD 250 KNOTS IN A TURN.

YOUR ATTENTION THEN GOES BACK TO THE BANK POINTER, MONITORS THE BANK AND THE PITCH AND CROSSCHECKS THE OTHER PERFORMANCE INSTRUMENTS.

YOU'LL NOTICE THE HEADING INDICATOR IS SLOWLY PROGRESSING TOWARD THE DESIRED HEADING. AT 10 DEGREES PRIOR TO THE HEADING THE EYES RE-TURN TO THE ATTITUDE INDICATOR AND THE ROLLOUT IS INITIATED. THE BANK IS RETURNED

TO ZERO AND THE HEADING WILL STOP AT THE

CUT TO TACHOMETER.

DESIRED 270 HEADING. AS SOON AS THE BANK IS REGAINED. THE POWER IS REDUCED BACK TO THE LEVEL SETTING OF 81.5%.

FILM CLIP NORMAL 30° RIGHT TURN.

THE NEXT MANEUVER WILL BE A NORMAL 30 DEGREE BANK TURN TO THE RIGHT, THE ENTRY WILL BE SIMILAR.

THE ATTENTION AT THIS POINT, IN STRAIGHT AND LEVEL IS ON THE ATTITUDE INDICATOR.

INITIATE THE YOKE TO THE RIGHT MONITORING THE

CUT TO TACHS.

ATTITUDE INDICATOR UNTIL THE BANK IS ESTABLISHED AT 30 DEGREES. SHORTLY AFTER THE BANK IS ESTABLISHED, THE RPM IS INCREASED TO 83%.

ONCE THE POWER IS SET, THE CROSS CHECK RETURNS TO THE BANK AND THE PITCH, AGAIN RHYTHMICALLY CROSS CHECKING THE PERFORMANCE INSTRUMENTS FOR DIVIATIONS. NOTICE THAT THE HEADING IS PROGRESSING TO THE RIGHT TO 090.

AT 080, OR 10 DEGREES PRIOR, YOUR ATTENTION GOES BACK TO THE ATTITUDE INDICATOR AND THE ROLLOUT IS INITIATED. AGAIN, A ZERO BANK IS ESTABLISHED AND YOU WILL NOTICE THE HEADING IS ON 090. SHORTLY AFTER THE POWER IS REDUCED TO 81.5%.

FILM CLIP CONSTANT AIRSPEED CLIMB SEQUENCE.

THE NEXT MANEUVER WILL BE A CONSTANT AIRSPEED CLIMB FROM 15,000 FEET TO 17,000 FEET.
FROM STRAIGHT AND LEVEL, WE MAKE A PITCH CHANGE ON THE ATTITUDE INDICATOR OF APPROXIMATELY 4 DEGREES. SIMULTANEOUSLY, AS THE PITCH IS BEING INCREASED TO THE APPROXIMATE SETTING, THE RPM IS INCREASED TO FULL POWER, APPROXIMATELY 92%.
AT THIS POINT THE PITCH ATTITUDE AND THE AIRSPEED ARE MONITORED IN CONJUNCTION WITH EACH OTHER. . .SO THAT A CLIMB IS ESTABLISHED WITH FULL POWER WHICH MAINTAINS 250 KNOTS.
WE'RE NOW IN THE STEADY-STATE PORTION OF THE CLIMB, OUR CROSS CHECK SHOULD BE RHYTHMIC, SCANNING EACH INSTRUMENT FOR DEVIATION.
WE NOTICE THE ALTIMETER IS PASSING THROUGH 16,000 FEET, OUR INTENTION IS TO LEVEL OFF AT 17,000 FEET. THE LEVEL OFF LEAD POINT CALCULATION IS 10% OF THE VERTICAL VELOCITY. IN THIS CASE, WITH ALMOST 2,000 FPM, APPROXIMATELY 200 FEET PRIOR, WE WILL INITIATE THE LEVEL OFF.
SO AT 16,800 FEET OUR ATTENTION CENTRALIZES ON THE ATTITUDE INDICATOR AND THE NOSE IS LOWERED TO LEVEL FLIGHT. ONCE THIS ATTITUDE IS ESTABLISHED, WE MONITOR THE ATTITUDE, VVI, AND

AIRSPEED FOR THE CORRECT READINGS. THE RPM IS THEN REDUCED BACK TO THE SETTING FOR LEVEL FLIGHT AT 17,000 FEET WHICH IS 82.5%.

FILM CLIP CONSTANT AIRSPEED DESCENT.

THE LAST MANEUVER WE WILL BE DOING IS THE CONSTANT AIRSPEED DESCENT FROM 15,000 FEET TO 13,000 FEET. AS IN THE CLIMB, AT THIS POINT OUR ATTENTION IS ON THE ATTITUDE INDICATOR, LOWERING THE NOST TO APPROXIMATELY 4 DEGREES OF PITCH. ONCE THE PITCH IS ESTABLISHED, WE ALLOW THE VERTICAL VELOCITY TO SETTLE AND REDUCE THE POWER SIMULTANEOUSLY TO IDLE. AT THIS POINT THE PITCH ATTITUDE AND THE AIRSPEED ARE CLOSELY MONITORED TOGETHER SO THAT WE USE THE PITCH AS REQUIRED TO MAINTAIN 250 KNOTS. WE MONITOR HEADING TO MAINTAIN 360 OR DUE NORTH. WE MONITOR THE VERTICAL VELOCITY TO SEE WHAT IT IS SHOWING AND WE MONITOR THE ALTIMETER TO SEE HOW WE ARE PROGRESSING IN OUT DESCENT TO 13,000 FEET. HERE IS ANOTHER EXAMPLE OF APPROXIMATELY 150 TO 200 FEET OF LEAD REQUIRED. AT THAT POINT YOUR ATTENTION CENTRALIZED ON THE ATTITUDE INDICATOR. THE PITCH ATTITUDE IS AGAIN RETURNED TO THE LEVEL FLIGHT PICTURE, THE POWER IS SIMULTANEOUSLY APPLIED TO THE LEVEL POWER SETTING FOR 13,000 FEET OR 80.5%. YOUR ATTENTION RE-

TURNS TO THE ATTITUDE INDICATOR, AND THE PRIMARY INSTRUMENTS AND WE'RE ONCE AGAIN IN STRAIGHT AND LEVEL FLIGHT.

MS NARRATOR

THAT CONCLUDES OUR PRETRAINING VIDEOTAPE BRIEFING. THIS BRIEFING WILL BE FOLLOWED IMMEDIATELY BY A 30-QUESTION CRITERION MEASUREMENT. THANK YOU.

CLOSING GRAPHIC
TITLE OF STUDY AND
WORK UNIT.

☆U.S. GOVERNMENT PRINTING OFFICE: 1976- 671-613/62